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U. S. DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT

OF THE

OFFICE OF EXPERIMENT STATIONS

FOR THE YEAR ENDED JUNE 30,

1912.



WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1913.

JOINT RESOLUTION Providing for printing annually the Report of the Director of the Office of Experiment Stations, Department of Agriculture.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed eight thousand copies of the Report of the Director of the Office of Experiment Stations, prepared under the supervision of the Secretary of Agriculture, on the work and expenditures of that office and of the agricultural experiment stations established in the several States and Territories under the act of Congress of March second, eighteen hundred and eighty-seven, for nineteen hundred and three, of which one thousand copies shall be for the use of the Senate, two thousand copies for the use of the House of Representatives, and five thousand copies for the use of the Department of Agriculture; and that annually hereafter a similar report shall be prepared and printed, the edition to be the same as for the report herein provided.

Approved, April 27, 1904.



THE OFFICE OF EXPERIMENT STATIONS.

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 MRS. C. E. JOHNSTON, Chief Clerk.
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 W. H. EVANS.
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¹ On furlough.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., March 18, 1913.

SIR: I have the honor to transmit herewith the annual report of the Office of Experiment Stations, the publication of which is authorized by joint resolution of the Fifty-eighth Congress, second session. This includes a report on the work and expenditures of the agricultural experiment stations established under the act of Congress of March 2, 1887, and further endowed under the act of Congress of March 16, 1906, for the fiscal year ended June 30, 1912, in compliance with the following provision of the act making appropriations for this department for the said fiscal year:

The Secretary of Agriculture shall prescribe the form of the annual financial statement required under the above acts, ascertain whether the expenditures are in accordance with their provisions, and make report thereon to Congress.

Very respectfully,

A. C. TRUE, *Director.*

Hon. D. F. HOUSTON,

Secretary of Agriculture.

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ANNUAL REPORT OF THE OFFICE OF EXPERIMENT STATIONS, 1912.

WORK OF THE OFFICE OF EXPERIMENT STATIONS.

The work of the Office of Experiment Stations during the year ended June 30, 1912, was not different in general character from that of previous years. It was, however, materially increased to keep pace with the growth of the activities of the State and insular experiment stations; the development of agricultural education, especially in extension lines; and the progress of the special investigations under the direction of the office in human nutrition, irrigation, and drainage. A record of progress in the various activities of the office is given in the following pages under the heads of relations with the experiment stations, including a detailed report upon the work and expenditures of the experiment stations in the United States and the insular possessions; statistics of the land-grant colleges and experiment stations; nutrition, irrigation, and drainage investigations; and the promotion and progress of agricultural education, including also a detailed report upon farmers' institutes and agricultural extension work.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The advisory functions of the office have increased materially with the growth of the extension enterprises in the colleges with which the stations are connected. Numerous questions regarding the proper organization of extension work and its correlation with the work of the stations have received attention.

In its supervisory relations the office has, as in the past, directed its attention to holding the expenditure of the Federal funds within the terms of law and stimulating the stations and their staffs to work of more thorough and permanent character. This is effected through the annual inspection of the stations and by correspondence and publications. The spirit as well as the letter of the original acts is considered, and the attempt is made, without interfering with the management of the stations, to guide them into the proper channels of effort, to conserve the time and the energy of their investigators, and to give continuity and a large element of permanency to their work.

The general purpose is to aid the stations in securing the largest possible return from these funds in the form of productive, objective experiment and investigation, which shall furnish a store of new and tested knowledge, a better understanding of the reason behind empirical results and rules, and the development of more logical methods of practice. The idea is not that the stations shall confine themselves to theoretical studies or to the purely technical phases of agricultural questions, but that their field is primarily the acquisition and adaptation of knowledge rather than the diffusion of general information. Their work should form the basis for a larger enlightenment in respect to all that pertains to the farming industry. The farmer rarely needs to be taught skill in manipulation, and if he does he should not look to the experiment station to supply it. This is largely a product of experience; and he is not most helped by a collection of rules of thumb—by directions which have been thought out for him by others. But what he most needs is understanding, as a safe basis for judgment and intelligent application of what is worked out for him through experiment and investigation and the results of experience. It is necessary for him not only to do but to understand. The experiment station is the institution provided to furnish the basis of this understanding, and its acquisition is conceived to be the real purpose of the Federal appropriations. This view has guided the office in its examination of the funds and in advising as to the policy of concentration and development of the stations.

There has been general improvement in the method of handling the station accounts. As a rule the system has been simplified, and the expenditures of Federal funds have been supported by a set of vouchers which relate only to the station business. More care is being exercised to secure uniformity in the classification of items, and the liabilities of the stations are now generally carefully kept.

Efforts have been continued to secure a larger amount of definite experimental work with the Hatch fund by relieving it of charges for general maintenance, compiled publications, and expenses which are on the border line between station and extension work. This line has been more closely drawn than ever before, and in addition strong efforts have been made to have the expenses for general maintenance assumed by some other funds. This is done to an increasing extent in the larger institutions, and in the case of those without definite State appropriation for the station the college is urged to relieve the station to a larger extent of these miscellaneous charges.

The changes in the directors of a number of stations, under which new men have been brought in, have called for an unusual amount of attention to those stations in order that their administration might continue without interruption or loss of efficiency. Unsettled conditions in a few of the institutions have also called for a closer follow-

ing up of their affairs and special efforts to bring about a more stable situation.

The present large duties of some of the administrative officers make it difficult to secure proper consideration of matters of importance relating to the station work and funds. This is especially the case where the station is in charge of the dean of the college of agriculture, who also has under his direction the rapidly growing extension work. It is becoming very apparent that a division of duties is required, in order to enable the attention and consideration which the best interests of the stations require. This can be accomplished by the provision of a separate director or associate, reporting to the dean, who will act as administrative head of the station. Such an officer is much needed and such an arrangement has been urged by the office in a number of instances.

The search for men for the station work has continued, and the many changes which have come about during the year have resulted in unusual calls on the office for assistance in recruiting the station forces. There is a fuller realization that men are the chief limiting factor in the development of the station work. Many are being attracted by commercial positions which offer larger salaries, and extension activities which give them a closer contact with practice and secure quicker results. Every reasonable effort should be made to hold men in the station work who have demonstrated special ability in that field of activity, and in effecting this the provision of the right conditions in surroundings, freedom from distraction, and an atmosphere favorable to investigation count as well as salary. The productive investigator is entitled to a compensation which not only suffices for the needs of himself and family but recognizes his worth and position; but his largest return comes from the satisfaction of accomplishment, of doing the things he likes to do in the way which his science dictates, and seeing the results work out in a contribution to man's knowledge and to his intelligence and efficiency. The office has therefore favored the payment of adequate salaries, and has recognized this as one of the most legitimate uses of the station funds.

The propriety of sending investigators from one institution to another to pursue their researches has raised an important question of policy, which needs careful consideration in individual cases. It frequently happens that a point is reached in the course of an investigation where with the facilities at hand it can not further be prosecuted to best advantage. Theoretically, there would seem to be no reason why advantage should not be taken of the facilities and advice which can be secured at some other institution, provided this is within the means of the station and the further prosecution of the investigation is of sufficient importance to the State. The office has

consented to such an arrangement in one or two cases, under prescribed conditions, but it is realized that such an arrangement is open to abuse and calls for careful control. The actual needs of the investigation rather than the desire of the worker must determine the expediency of his taking his work to another institution, and in any event an arrangement must be made which will maintain the station's control over his work and prevent its developing into purely theoretical lines. On the whole, the practice is not one to be generally encouraged, but only to be resorted to in an exceptional case and where a mature worker is involved.

A review of the year and a report of progress by the stations collectively and individually is given on page 43.

INSULAR EXPERIMENT STATIONS.

A successful year has been reported at the stations maintained by this office in Alaska, Hawaii, Porto Rico, and Guam, under the clause of the act¹ authorizing the Secretary of Agriculture to establish and maintain agricultural experiment stations in these possessions and appropriating for the first three \$30,000 each and for the last \$15,000. The administrative work connected with these stations was, as in previous years, in charge of Walter H. Evans.

The policies early adopted for each of the stations have been continued, and with only a few changes in the personnel the investigations have been prosecuted without serious interruption. The adoption of new agricultural industries in the regions where the stations are situated seems to indicate the value of pursuing a policy of diversified agriculture. Some of these new industries are the direct outgrowth of the stations' investigations, while others have been very materially advanced by their activities and are now becoming of considerable economic importance. The stations are rapidly gaining the esteem and confidence of the people for whom they are maintained. This is shown in the local and cooperative support, the requests for specific advice, publications, seeds, plants, etc. All these requests are granted so far as the facilities of the stations will permit without infringing on the investigational work. As investigations into the fundamental principles underlying agriculture in the different regions are so important, this line of work is being especially fostered, and the results when ready for application are given publicity by every available means.

The Alaska stations are continuing their work upon well-established lines. At Sitka the headquarters of the stations are maintained and horticultural investigations are given prominence. The work with

¹ Act making appropriations for the U. S. Department of Agriculture for the fiscal year ended June 30, 1912.

fruits is beginning to give results. Several varieties of apples and cherries have ripened their fruit, indicating that certain varieties may produce fruit in southeastern Alaska. As soon as stocks are available these will be given a wide trial under other conditions. The work with bush fruits has been very successfully carried on with currants, gooseberries, raspberries, etc., and a number of methods of propagation that are especially adapted to Alaskan conditions have been worked out. The hybridizing of wild and cultivated strawberries has been continued and already a number of new varieties of excellent character have been produced. Among the experiments with vegetables especial attention has been given to the testing of varieties to determine their adaptability to Alaskan conditions. These experiments have been carried on especially with potatoes, cabbage, cauliflower, and lettuce, and for each vegetable certain varieties stand out as especially well suited to that country. Some work with ornamental perennials has been begun with satisfactory results. In a limited way the possibility of poultry raising has been taken up and it will be continued to get data on egg and poultry production. At the Rampart station cereal production is given prominence, but some work with vegetables and forage plants is being carried on. Among the noteworthy results of cereal breeding experiments are the improvement of oats by selection and the securing by crossbreeding of varieties of barley that give indication of being earlier in maturing than any variety known and at the same time of merit regarding yielding capacity and character of the grain. Some very successful introductions of grasses and other forage crops have been made, and the hardiness of some races of alfalfa seems to be demonstrated. Experiments with potatoes have shown that certain varieties are especially adapted to the interior of Alaska, and these are being propagated as rapidly as possible. Other vegetables are grown on a small scale to test their adaptability. It has been demonstrated at the Rampart station that seed of peas, turnips, and possibly other vegetables can be locally grown, and in comparison with introduced seed they have proved decidedly superior. At the Fairbanks station an attempt is being made to develop a farm along the lines that settlers will probably have to follow. For the present grain, potatoes, and hay are the principal crops grown. Three acres of potatoes on land that had been previously cultivated produced over 600 bushels of marketable tubers, or at the rate of more than 200 bushels per acre. On 4 acres of newly cleared land the production was at the rate of about 125 bushels per acre. Hay production, especially from grain sown for the purpose, has proved quite profitable. The experiments with grain have again shown that varieties of oats and barley can be depended upon to ripen every year, and winter

wheat and rye whenever there is snow enough to prevent winter-killing. Experiments at Rampart and Fairbanks have shown that the soil needs an application of nitrogenous fertilizer, the addition of phosphoric acid and potash not being necessary as yet. The live stock investigations with cattle and sheep on Kodiak Island have made very satisfactory progress. Nearly 100 head of Galloway cattle and an equal number of grade sheep have been successfully kept on pasture and wintered on hay and silage made from wild grasses. A portion of the station land has been plowed and seeded to oats for hay, and yields of 2 tons per acre have been secured. This experiment has fully demonstrated the possibility of stock raising in this part of Alaska. In order to improve the milking qualities of the Galloway herd, 11 cows with good milking records were purchased in the spring of 1912. Just before they were shipped from Seattle a volcanic eruption on the mainland some 95 miles away covered the station with ashes to such a depth as to destroy all pasture and prospect for hay and it was necessary to remove the stock. The best of the cattle were shipped to Toppenish, Wash., where they were placed on pasture, and the older animals and the grades were sent to Seward, where they were sold. Experiments have shown that crops can be grown at the station if the volcanic ash is given an application of fertilizers or if mixed with the underlying soil by plowing. It is intended to seed 200 acres or more with grasses, grains, and leguminous forage crops in the spring of 1913 and to return the stock as soon thereafter as conditions will warrant. The tract of land on Kalsin Bay occupied by the station as a stock ranch was set aside for its use by Executive order dated April 1, 1912.

At the Guam station the introduction of new crops, improved live stock, and better methods of agricultural practice are being given especial attention. The experiments in connection with forage production have been remarkably successful. Para grass (*Panicum molle*) has proved the best among the grasses, with *Paspalum dilatatum* and Guinea grass (*Panicum maximum*) giving satisfactory results. Kafir corn and sorghums have done well, and among leguminous plants the pigeon pea, jack bean, and peanut have proved worthy of note. An extensive experiment with corn, a staple food of the island, has been begun, and comparisons are being made between many varieties received from other tropical countries and the kinds commonly grown upon the island. Preliminary reports indicate greater yields from some of the introduced varieties. The work with vegetables has shown almost invariably increased productivity and improvement in quality over the earlier experiments. A number of promising varieties new to the island have been introduced. The introduction of tropical fruits is being continued. The Hawaiian pineapples have proved so superior that there are large demands for

suckers for planting. The improved live stock introduced for breeding purposes in the fall of 1911 have for the most part done well, and they are apparently a valuable addition to the stock of the island. This is especially true of the pigs and poultry. The results with the horses and cattle will be slower, and some time must elapse before the success or failure of this experiment can be established. During a portion of the year D. T. Fullaway, entomologist of the Hawaii station, was detailed to make a preliminary study of the insect fauna of the island. Extensive collections were made and notes taken of their effect on economic plants, and a preliminary report was given in the report of the Guam station.

In Hawaii the policy of the station has been for the diversification of agriculture. The Hawaiian Sugar Planters' Association has an experiment station at which the problems peculiar to their crop are studied, and the station maintained by this office gives attention to other agricultural crops and industries. Since the station was established the pineapple industry has advanced to second rank among the industries of the Territory. Large areas are now planted to this crop, and with the expansion of the industry the station has given much attention to the questions of soils, fertilizers, utilization of waste products, etc. Soil surveys have been made, particularly with reference to the presence of manganese, a content of 2 or more per cent of that substance having been found detrimental to pineapple growing. Cotton growing continues to be given attention, and it has been shown that cotton of good quality can be grown on low, lands or where the plants are not exposed to the strong trade winds. At present the Caravonica cotton seems best adapted to growing in Hawaii, and tests have shown that the saw gin may be safely used for ginning this cotton, the waste being very slight if the gin is not run at too high speed. The rice investigations have been continued along the original lines, and it has been conclusively shown that the Japan rices can be grown in Hawaii without deterioration in quality. The fertilizer experiments again have indicated that ammonium sulphate, or some organic source of nitrogen, is a better fertilizer for rice as grown in Hawaii than nitrate of soda. Applications made before the crop was sown gave better results than partial applications at intervals during the growing of the crop. Similar results have been obtained in experiments in growing taro. A study has been made of the waste from decorticating sisal leaves and of the possible utilization of the fiber in pineapple leaves. Extensive cooperative experiments are in progress on range restoration, and some forage plants have been introduced that appear promising. The entomologist has continued his investigations of the Mediterranean fruit fly, parasites of the pink bollworm, algaroba-bean weevils, scale insects, mosquitoes, etc., and has developed new facts concerning

them. The horticulturists are continuing their studies on methods of propagating various tropical plants as well as breeding experiments with pineapples and other economic and ornamental plants. Some investigations have been made on the methods of packing and shipping bananas and pineapples, the quarantine against the Mediterranean fruit fly making it important that these fruits should be properly handled so as to not become sources of possible infection. Chemical studies have been made of the sulphur and chlorin content of the rice plant, the form in which nitrogen occurs in Hawaiian soils, rubber extraction, etc. In connection with the rubber studies, a new source of rubber was found in *Euphorbia loricifolia*, a native tree that is abundant on the island of Hawaii. Through the assistance of Territorial and other funds several demonstration farms have been established on the different islands. At these different stations local problems are studied and demonstrations made of the adaptability of crops, methods of cultivation, marketing, etc. At Glenwood, on the island of Hawaii, a cooperative dairy has been established that gives promise of proving successful.

The work of the Porto Rico station for the diversification and improvement of agriculture is being continued along the same lines as have been previously reported. The establishment of an experiment station by the Sugar Planters' Association has relieved the station of some work that had formerly been carried on with sugar cane. The investigations on citrus fruits have received considerable attention by different members of the staff. The remarkable success attained with grapefruit and oranges in Porto Rico can be largely attributed to the station's investigations on the use of fertilizers, methods of orchard management, tests of varieties, studies of insect and fungus pests and their control, etc. The development of the citrus and pineapple industries has placed fruit growing third among the agricultural industries of the island, the exports in 1911 amounting to over \$2,000,000. The rapid increase in the value of exported fruits is largely due to better methods of shipment, experiments having shown the value of careful handling, grading, and packing of the fruit. The plantings of mangoes, avocados, and other tropical fruits are being extended, and there is a constant demand for the surplus stock of these fruit trees. The use of cover crops in connection with orcharding is being studied and an especially interesting series of experiments with cover crops for coconut groves is in progress. Variety tests and experiments in planting, fertilizing, and cultivating sweet potatoes, yams, yautias, and other root crops are being carried on, and some important results have been obtained. The work with vegetables is being continued along the usual lines, attempts being made to secure varieties and methods of cultivation

adapted to Porto Rican conditions. An experiment in the reforestation of the denuded hillsides has been begun, various species of eucalyptus being tested for this purpose. The chemical work of the station consists largely of soil studies, especially of the action of lime in inducing chlorosis of pineapples and other plants. Some investigations have been running for several years on the causes of the so-called "sick soils" and methods for their improvement. Some studies were made on the relation of the lime-magnesia ratio to plant growth, and a bulletin on this subject has been prepared. The entomologist and the plant pathologist have given especial attention to coffee pests as well as those of the coffee shade trees. In addition a bud rot of coconut trees and a canker of cacao trees have been investigated by the plant pathologist. Some work was also done on citrus diseases and methods of control. The entomologist investigated the mango fruit fly (*Anastrepha* sp.) and also various beneficial insects and fungi for the control of insects injurious to economic plants. The investigations on the introduction of varieties of coffee from other countries, renovation of coffee plantations, etc., have been continued with success, and a considerable number of the trees of the new varieties are bearing. A constant demand for the seed of these trees exists and as far as supplies are available they are distributed for planting. The animal husbandry work has largely been confined to breeding experiments with horses, cattle, swine, and poultry. During the year all the hogs died from some infectious disease, but the work will be resumed. Some attention has been given to the production of forage and a number of promising forage plants have been introduced and are being given trial. Some investigations on the sanitary handling of milk have been begun and other dairy problems will be taken up as the station's resources will permit.

For more detailed accounts of some of the stations' work see pages 71, 100, 101, 193.

NUTRITION INVESTIGATIONS.

All foodstuffs are the products of agriculture, and the nutrition investigations of the Office of Experiment Stations were organized to study the relative nutritive value of these products, both animal and vegetable, and economical ways of using them. The clause of the appropriation act of the department under which the work was done during the year covered by this report authorized the Secretary of Agriculture "to investigate the nutritive value of agricultural products used for human food, with special suggestions of plans and methods for the more effective utilization of such products for this purpose * * * and to disseminate useful information on this subject." C. F. Langworthy has continued in charge of these investigations.

During the year studies on the relative energy expenditure in the digestion of cheese and meat were continued, and, as heretofore, no marked differences have been found in this respect between the two foodstuffs.

The studies of the ripening of fruit (bananas) carried on in cooperation with the Bureau of Chemistry, with the small respiration calorimeter designed particularly for such work, were continued, and information which promises to be of much practical as well as theoretical importance was accumulated. As an indication of the character of the energy changes which take place, it may be stated that during the most active period of the ripening of bananas, under conditions comparable with those followed in the trade, the heat output was found to be approximately one-half calorie per hour per kilogram of fruit. The results of these investigations, together with others carried on by the department, give information of interest not only to the housewife but also to the shipper and dealer.

Experimental studies were made of the relative nutritive value of culinary and table fats, and related questions. This work is being continued with a view to accumulating data of interest to the housekeeper, producer, and manufacturer, a part of it being undertaken in cooperation with the Bureau of Animal Industry of this department.

During the year particular attention was paid to the nutritive value, preparation, and use in the diet of mutton, the results being embodied in a Farmers' Bulletin which discusses the importance of this foodstuff, describes numerous ways of using it in palatable dishes, and gives general information of interest to the housekeeper.

The culinary quality and importance of corn meal, methods of preparing corn meals of different sorts to secure uniform results, ways of using corn meal, and other questions, were studied, the results being brought together in a Farmers' Bulletin on corn meal and its use in the diet. Special attention was paid to collecting information from northern and southern States regarding the methods of using corn meal which have been proved satisfactory by the experience of many years. In addition to general discussions of the food value and the use of corn, a large number of standardized recipes for the use of this important foodstuff are given.

Some attention was paid to the study of food supply and cost and to other general questions. A series of experiments was begun in cooperation with the Bureau of Animal Industry on the relative nutritive value and digestibility of meat of different sorts and the effect of different factors upon nutritive value.

Mention should also be made of the experiments undertaken in cooperation with the War Department and with the Smithsonian

Institution on the digestibility and nutritive value of special food products.

Some attention was also given to the study of the preparation and use of vegetables as food and dried and evaporated fruits, to the construction and use of the fireless cooker, to kitchen conveniences for farm and other homes, and to the preparation of publications on such topics.

Papers were also prepared for the international congresses held during the year in Washington, and for other similar purposes. Exhibits illustrating the work of the nutrition investigations were prepared for the Fifteenth International Congress on Hygiene and Demography, and for other similar purposes.

The work of collecting and editing data on food and nutrition topics was continued as well as the preparation of material for publication in the Experiment Station Record and in the Experiment Station Work series of Farmers' Bulletins. An increasingly large amount of time is required for this work as well as for furnishing, by correspondence or otherwise, the information on nutrition and related topics, which is requested from the department by housekeepers, teachers, physicians, and others.

IRRIGATION INVESTIGATIONS.

Irrigation investigations were conducted during the year along the same general lines as heretofore, under the direction of Samuel Fortier. The work was done in conformity with the clause in the appropriation act of the department authorizing investigation and report on irrigation laws and institutions "and upon the use of irrigation waters, at home and abroad, with especial suggestions of the best methods for the utilization of irrigation waters in agriculture, and upon the use of different kinds of power and appliances for irrigation." The more important work carried on in the several States is described in the following paragraphs:

ARIZONA.

A detailed investigation was made and report prepared on the irrigation possibilities of the Santa Cruz Valley. Preliminary investigations of a similar nature were made in a number of other sections of the State. Experiments have been conducted on a 5-acre tract at Higley to ascertain the amount of water needed and the best methods of applying it to citrus and deciduous trees and forage crops. Much information and assistance have been given irrigators of the State through letters, personal visits, and addresses before meetings of farmers and commercial clubs.

CALIFORNIA.

The agreement for cooperation entered into with the State engineering department of California in 1909 was continued. The work during the present year consisted of investigations of the following: The irrigation possibilities of the foothill region west of the Sierra Nevada Mountains; the irrigation of cotton in the Imperial, Yuma, Coachilla, and Palo Verde Valleys; the storage of storm waters of the Santa Ana River and other streams by spreading them over the gravels below where the streams leave the canyons; the use of fuel-oil and producer-gas plants for pumping; subirrigation; methods and costs of cleaning ditches; the organization and management of irrigation districts and mutual water companies; measuring devices; and duty of water.

The University of California continued to cooperate by furnishing State headquarters and land at its Davis farm for the duty of water and measuring-device experiments.

In addition to the regular cooperative work, data were collected under an agreement between the Department of Agriculture and the Conservation Commission of California, and reports were prepared setting forth the surface and underground water supplies available for irrigation; the extent, character, and location of agricultural land susceptible of irrigation; the present extent of irrigation; and the extent and location of unused waters. These reports, together with irrigation maps of the northern, central, and southern parts of the State, were prepared for publication by the department and the conservation commission. In connection with this work, studies were made of the use and duty of water in the Shasta Valley, along the Feather River in the Sacramento Valley, the San Joaquin Valley, the Santa Clara Valley, and the Santa Ana Valley.

COLORADO.

Cooperative irrigation work was begun with the Colorado State Agricultural Experiment Station on July 1, 1911. This necessitated an almost complete reorganization of the work in this State. The demonstration farm, which has been maintained at Eads for five years, was discontinued June 1, 1912, and the irrigation farmer assigned to securing data and advising irrigators in the eastern part of the State. Preliminary investigations were made in the San Luis Valley preparatory to the undertaking of a careful and detailed study of some of the important irrigation problems of that section. Three experimental and demonstration farms of 40 acres each have been established near Acacio for the purpose of investigating the irrigation possibilities and demonstrating the crops, irrigation methods, and practices best adapted to that part of the State. Experiments were

conducted at the experiment station farm at Fort Collins to determine the water requirements of crops, the permissible height of the water plane with different crops, the rates of capillarity and percolation in Colorado soils, and the coefficient of friction in earthen channels, flumes, and siphons. In the spring of 1912 arrangements were made with the State Agricultural College of Colorado and the experiment station to equip a hydraulic laboratory at which cooperative experiments could be made to develop formulas for the flow of water through pipes, gates, and orifices of different kinds over weirs of different types, and to ascertain the effects of different common field conditions upon the flow of water through gates, measuring devices, etc. The experiments will be begun during the fiscal year 1913 and will be carried on as rapidly as possible for several years.

IDAHO.

The work for the fiscal year 1912 followed the same general line as heretofore, namely, (1) experiments at Gooding in cooperation with the Idaho State Agricultural Experiment Station to ascertain the effect of irrigation at different stages of growth upon the yield and quality of grains, alfalfa, and potatoes; (2) duty of water investigations carried on in cooperation with the State engineer's office; and (3) advising and assisting irrigators. The Gooding experiment farm of 40 acres was divided into 350 plats, ranging from one-twentieth to 1 acre each, approximately half the area being devoted to the general crop experiments and half to duty of water investigations for spring and winter wheat, barley, oats, potatoes, and alfalfa. In cooperation with the State engineer, measurements of the amount of water used were made on approximately one hundred fields, representative of different crops and soil conditions of southern Idaho. These measurements, and similar ones made in the fiscal year 1911, show that on average southern Idaho soils a project devoted half to alfalfa and half to grains, or similar crops, requires 2 acre-feet of water per acre delivered at the fields.

KANSAS.

Investigations were made during the year of the irrigation possibilities in the northwestern part of the State, in the artesian district of the southwestern part of the State, and the Arkansas Valley from Syracuse to Wichita, and settlers in these sections were furnished information regarding pumping, irrigation methods, and the cost of irrigation. During the summer of 1911 the Kansas Agricultural Experiment Station, Finney County, and the Commercial Club of Garden City installed at the Garden City substation of the experiment station a pumping plant to be used in conducting experiments in cooperation with this office. The plant consists of a 24-inch well 135

feet deep, a 75-horsepower fuel-oil engine, and a turbine pump having a capacity of 750 gallons per minute. In the spring of 1912 a tract of 8 acres was laid out in one-fifth acre tracts, and experiments started to determine the crops best adapted to irrigation in western Kansas, the best methods of applying water, and the cost of irrigation from wells in the Great Plains region.

MONTANA.

Data were collected as to the extent of irrigation, the methods and practices in use, and the problems confronting the irrigators. Investigations also were begun to ascertain the amount of seepage from canals and the duty of water in the Bitter Root Valley and other sections of the State.

NEBRASKA AND SOUTH DAKOTA.

The work in these States, as heretofore, consisted almost entirely of collecting data regarding irrigation methods, conditions, and possibilities, and of advising irrigators and irrigation companies as to better methods and practices.

NEVADA.

The work carried on in cooperation with the Nevada Agricultural Experiment Station and the State engineer has consisted of three lines, namely: (1) A study of the methods of applying water, of the losses of water due to evaporation and seepage, and of the amount of water necessary to produce a pound of dry alfalfa or wheat; (2) investigations to ascertain the seepage and evaporation from the Humboldt River and tributary streams, the storage possibilities, the appropriations, and the duty of water in the several valleys; and (3) the advising and assisting of irrigators with a view to bringing about better methods of preparing lands, applying and measuring water, draining irrigated lands, and pumping.

OREGON.

During the first part of the year data were collected for the revision of the bulletin on irrigation in Oregon. A general duty of water investigation was begun in the vicinity of Bend in the spring of 1912.

NEW MEXICO.

Experiments were conducted during the year in cooperation with the New Mexico Agricultural Experiment Station to determine the flow of water through submerged orifices and over weirs, the cost of irrigating, the best methods of applying water, and the amount of water required at each irrigation in irrigating orchards. Investiga-

tions have also been conducted to obtain data pertaining to duty of water for different crops, pumping plants, method of irrigating, etc.

TEXAS.

Owing to the large field to be covered, the time of the agent in this State is devoted largely to advising irrigators and companies. Data were collected and investigations made during the year regarding the irrigation of cotton and sugar cane and subirrigation methods. An examination was made to ascertain the possibilities and cost of irrigation by pumping in the Panhandle.

UTAH.

The greater part of the funds allotted to this field was used in investigating, in cooperation with the Utah Agricultural Experiment Station, the effects upon the yield and quality of peaches and various field crops, of applying different amounts of water, and applying it at different stages in the growth of the crops. The experiments show that the time of applying water affects the yield more than does the amount applied, also that fruit buds may be changed to leaf buds and vice versa by varying the time and amount of irrigation.

WASHINGTON.

The more important works carried on in this State were the orchard investigations at Grandview and the investigation of the possibilities for irrigation in the section of the State west of the Cascade Mountains. It was shown by the investigations at Grandview that less water and fewer irrigations were required for orchards where a good dust mulch was maintained and where a red clover crop was grown between the trees. The investigation of the section west of the Cascades and the advising of settlers of that section regarding irrigation methods and practices, and the installation of pumping plants have awakened considerable interest in irrigation in that section.

WYOMING.

The work at the demonstration farms at Cheyenne and Newcastle has been continued along the same lines. An investigation was begun to ascertain the possibilities of obtaining water from the underflow of the small streams in southeastern Wyoming which are dry practically throughout the irrigation season. Six wells 14 feet deep were sunk, and two supply galleries with an aggregate length of 260 feet constructed in the bed of the stream on the Cheyenne farm in the spring and summer of 1912. Experiments will be continued during the next fiscal year to determine the amount of water available and the cost of pumping, using electricity for power. Five acres of highland were secured adjoining the Newcastle farm in

order that the results obtained in the irrigation experiments can be compared with crops raised under typical dry-farm conditions. Data were collected during the year as to the irrigation development in the State under the Carey Act and the irrigation district law.

RICE.

Experiments were carried on at Almyra and England, Ark., to determine the proper time to irrigate rice, the depth at which the water should be kept at different stages in the growth of the plant, and the effect of irrigation in checking or preventing the ravages of diseases and pests. During the year the agent in charge made trips through the rice regions of Arkansas, Louisiana, and Texas gathering data and advising rice growers.

HUMID SECTIONS.

The interest in irrigation in the humid section has continued to increase and the men stationed in this field and the Washington office have received numerous inquiries as to the possibilities, costs, returns, and methods adapted to the irrigation of truck, small fruits, orchards, and field crops in sections where only supplemental irrigation is required. Cooperative experiments were continued at Orlando, Fla.; Albany, Ga.; Selma, Ala.; Neenah, Wis.; and Rancocas and Vineland, N. J. Investigations were made to determine the costs, advantages and disadvantages, and possibilities of irrigation by means of overhead spray and subirrigation systems. Assistance has been given to representative farmers in several States in planning and installing systems with a view to having such plants serve as models to others planning to undertake irrigation.

POWER.

During the year data were collected regarding the underground-water resources of various sections, types of wells, pumps, windmills, fuel-oil and gasoline engines, and other appliances used to lift water for irrigation. Studies have been made of the types of wells, pumps, strainers, etc., best adapted to the recovering of water from the characteristic sands and gravels of the arid and semiarid regions. A number of detailed investigations have been carried on and reports made of the underground waters and the possibilities and cost of irrigation by pumping in sections of Arizona, New Mexico, and northern Texas. The pumping plant installed at Garden City, Kans., by the agricultural experiment station and Finney County for cooperative experiments with this office, was designed and its installation supervised by the agent in charge of power investigations.

MISCELLANEOUS INVESTIGATIONS.

In the spring of 1912 the office began the collection of data pertaining to gate structures of all sorts used on irrigation systems, with a view to preparing a bulletin setting forth types of gates and gate accessories which have proven successful under different conditions. The collection of these data will be completed and the bulletin prepared during the next fiscal year.

The results of the tank experiments which have been conducted for several years at seven places in the arid region, in cooperation with the State experiment stations, to determine the evaporation losses from irrigated soils were published near the end of the year. The equipment is now in use in a series of experiments to determine the amount of water required at different stages of growth of alfalfa for each pound of dry matter produced. The experiments with alfalfa will be completed during the fiscal year 1913, and similar ones will be undertaken with wheat and other grains.

Data were collected during the year regarding the organization and management of cooperative irrigation enterprises in Utah, the irrigation of sugar cane and cotton, the seepage from canals, methods and cost of lining canals, and subirrigation. The data collected in former years on dams and reservoirs were compiled and two bulletins published on the storage of water for irrigation.

DRAINAGE INVESTIGATIONS.

The drainage investigations of the year were conducted in accordance with the clause in the department appropriation act authorizing the Secretary "To investigate and report upon the drainage of swamps and other wet lands and to prepare plans for the removal of surplus waters by drainage." The work was in charge of C. G. Elliott until February 3, 1912. Thereafter, until the appointment of his successor, S. H. McCrory, July 16, 1912, E. W. Allen, assistant director, was temporarily in charge.

The demands upon the office for assistance in drainage matters continued to increase and reached a point where only a small part of the requests requiring a survey could be acceded to.

With the field engineers located in permanent headquarters, which are advantageously distributed over those parts of the country in which the need of drainage is greatest, the policy was to render service in an advisory or consulting way rather than by engaging extensively in the larger projects which would require the continuous services of the engineers for long periods. In other words, the endeavor was more to serve a large number of people in their less extensive drainage undertakings than to enter in detail into a comparatively few of the

larger enterprises. In general it is recognized that the work of the office along drainage lines should be largely educational in character, with the purpose of helping individuals and communities to help themselves most effectively.

While the general policy has been as outlined, it seemed advisable in a number of cases to make extensive surveys and detailed plans for drainage projects, two of which are among the largest yet undertaken by the office.

Drainage work as conducted by the office is concerned with both the arid and the humid sections. In the former the problems presented are those due to the rise of the ground water, which ordinarily takes place where irrigation is practiced. These problems are entirely different in character from those encountered in the humid section and require different treatment. This rise of ground water, accompanied so often by the accumulation of alkali at the ground surface, soon renders the land unfit for cultivation. It is due to one or more of the following causes: Leakage from irrigation canals and laterals, seepage from adjoining higher land, and the waste incident to the application of irrigation water to the ground itself. The work of the drainage engineer in the irrigated section is first to ascertain definitely the source and amount of the surplus water, and then to devise the most economical methods of preventing further damage, either through the application of corrective methods at the source or by diverting the subterranean flow before it reaches the damaged area. When it is considered that this injurious movement of water takes place wholly beneath the surface of the ground, it is readily realized that there is room for the display of the highest degree of judgment and the largest experience in the solution of these problems. In fact, it is only by the exercise of these qualities that the engineer can successfully cope with the problems, since the varying topographic and soil conditions make of each case a subject for individual study and treatment. The office maintained during the year in the irrigated sections of the West a staff of seven engineers whose entire time was devoted to studying and reporting upon the best practice in the treatment of seepage and alkali by drainage, and to giving assistance and advice to communities and individuals on definite drainage projects.

The work in the humid sections falls into three general subdivisions: (1) Improvement of farm lands now under cultivation; (2) drainage of swamp land; and (3) reclamation of overflowed land.

The improvement of farm land by tile drainage is a question of tremendous importance and of growing interest to farmers. There is an unceasing demand on the office for information and advice on this subject and for the services of its engineers to design, lay out,

and superintend the construction of tile drainage systems. There are few better investments that a farmer can make than to drain the wet portions of his farm, but the system must be intelligently designed and properly constructed. The disappointments that occur are invariably due to faulty work either in design or execution. These defects, with their consequent failures and disappointments, are usually due to the lack of appreciation on the part of the landowner of the importance of such details as density of soil, slope and topography of the ground, and the proper amount of drainage water to be provided for. Upon these factors depend the location, depth, spacing, and size of tile, details upon the correct determination of which hinges the success or failure of the system. The representatives of the office are constantly called upon to combat haphazard methods, and to demonstrate the economy of farm drainage where the work is designed and constructed under competent supervision.

The drainage of swamp land includes the improvement of such lands as are more or less continuously wet and unfit for cultivation, due to their small slope, lack of outlets, or the obstructed condition of the latter. There was more demand on the office for assistance in reclamations of this nature than of the other two classes mentioned, and the largest surveys made were of this type. The necessity for swamp drainage is now generally recognized, not only for the purpose of making available for cultivation large tracts of unproductive land, but also for improving the health conditions of the communities in which the swamps lie.

The overflow of streams presents drainage problems very different in character from those of the permanent swamps. The overflows are periodic and may be infrequent, but the resulting losses are often extremely heavy, due to the fact that the flooded bottoms are usually very fertile and are under cultivation. When a flood occurs during the growing season entire loss of crops in the part of the valley affected may result, and even when there is no crop loss the agricultural interests of the valley suffer through damage to land by the washing away of the rich top soil and by the deposit of sand. Reclamation of such overflowed areas usually is accomplished by improving the channel of the offending stream and by the construction of levees to confine the flood flow.

A considerable part of the time of the field force was taken up in making preliminary examinations of projected drainage undertakings. Such an examination is always made and a report submitted before a drainage survey is begun, and frequently the engineer is enabled to render such advice and make such recommendations as a result of this investigation that an extensive survey is unnecessary. These examinations constitute one of the most important features of the

work of drainage investigations, and a large number of them were made during the year.

As opportunity is presented the office carries on investigations for the accumulation of technical data relating to drainage. Some of the important lines of technical investigations pursued are: The relation of run-off to such controlling factors as rainfall and watershed characteristics; the selection of proper coefficients of flow for working conditions in various kinds of channels; the water storage capacity of soils; various technical questions relating to the subject of drainage by pumping; and problems peculiar to the drainage of irrigated lands.

IMPROVEMENT OF FARM LANDS.

J. V. Phillips made a survey and plans for a tile-drainage system on the farm of Judge Max L. McRae, near the town of McRae, Telfair County, Ga. Mr. Phillips also superintended the installation of the drainage system which included the laying of about 12,000 feet of tile. The system was designed to drain 56 acres.

Some experimental tile work was done on the farm of Mr. J. F. Clark, in Talbot County, Md. The purpose of the work was to demonstrate the feasibility of draining shallow ponds, which are of such common occurrence in Delaware and Maryland, and are due to the poor development of natural drainage. The work on the Clark farm consisted in connecting seven ponds, ranging from a few inches to 1½ feet in depth, by a single line of tile with suitable outlet. The work was done under the supervision of J. R. Haswell and was entirely successful.

On the farm of J. A. Arringdale, in Talbot County, Md., J. R. Haswell superintended the laying of 500 feet of tile to test the practicability of reclaiming a tract of hillside land made wet by seepage of spring water. One week after the drains were installed the ground was in condition for cultivation.

On the farm of Dr. Cora Belle Brewster, Aberdeen, Harford County, Md., about 4,000 feet of tile were laid as intercepting drains upon the recommendation of J. R. Haswell, who made a detailed examination of conditions.

At the request of the authorities of the North Carolina Agricultural and Mechanical College for the Colored Race, located at Greensboro, a survey and detailed plans were made by C. W. Mengel for draining the college farm, which contains about 107 acres. The work was done in the hope that, if successful, it would afford a practical demonstration to the students of the value of farm drainage.

J. R. Haswell surveyed and provided plans for draining 41 acres of wet land on the 1,270-acre tract of the Strathmore Orchard Co. (Inc.), which lies 2 miles southwest of Mount Jackson, Shenandoah

County, Va. The area covered by the proposed drainage system was in young apple trees, and some parts were so wet that the trees had been heaved entirely out of the ground by winter frosts. The plans called for laying about 12,000 feet of tile.

DRAINAGE OF SWAMP LANDS.

The Cypress Creek drainage district includes nearly the whole of that part of Desha County, Ark., lying south of the Arkansas River. The district contains 466 square miles. It is protected by levees from the overflow of the Mississippi and Arkansas Rivers, except where Cypress Creek enters the former stream, there being at this point a levee gap of about 2 miles. This opening admits the Mississippi flood water which, during the higher river stages, covers an immense area of the county. Owing to the low-lying character of the land of the district and lack of efficient outlet, overflow from the Mississippi, as well as that from the creeks and bayous which enter the district, passes off very slowly, the result being that large areas are wet or even covered with water for long periods. The office conducted a survey during the year of the whole area included within the Cypress Creek drainage district and formulated plans and estimates in detail for diverting Cypress Creek so as to permit closing of the levee gap. The plans also provided for draining all parts of the district by systematic channel improvement and by the construction of the interior mains and laterals necessary to afford quick outlet for all drainage water. The field work was in charge of O. G. Baxter, D. L. Yarnell, and L. A. Jones, assisted by A. G. Hall and W. J. Schlick. S. H. McCrory participated in formulating the drainage plan.

Plans and estimates were made by H. A. Kipp, after an extensive survey of the area, for the improvement of 2,285 acres of land lying along the Potomac River in Montgomery County, Md. This flat land holds the overflow water from the river and small tributary streams to such an extent that a large part of the area is kept in a condition too wet for cultivation.

Two tracts of low wet land, adjoining Beaver Dam Swamp and Dry Creek, in Harnett County, N. C., containing 4,000 acres and 3,500 acres, respectively, were surveyed by C. W. Mengel, who worked out plans for their drainage.

The Flea Hill drainage district in Cumberland County, N. C., in addition to the usual drainage problems common to that section, presented some features not usually encountered; these were in the nature of lowlands kept continually wet by the seepage from adjoining hill land situated outside of the district. C. W. Mengel was in charge of the survey and furnished plans for the amelioration of existing conditions.

The tract of the Georgetown Farm Land and Home-Seekers' Co., near Georgetown, Georgetown County, S. C., contains about 13,800 acres of low, flat land of considerable fertility, but which, owing to lack of drainage outlets, is too wet for cultivation. Necessarily, the first step in the development of those lands is to drain them. The office supplied a detailed drainage plan worked out by F. G. Eason, who made a complete drainage survey of the tract.

Near Summerville, Dorchester County, S. C., and bordering a small stream known as Saw Mill Branch, lies a low tract of land containing 18,600 acres, which is kept continuously wet by reason of the inefficiency of the branch as a drainage outlet. The conditions are peculiarly obnoxious owing to the proximity of the swamp to the town of Summerville. F. G. Eason, assisted by A. G. Hall, made a drainage survey of the tract and submitted estimates for improving Saw Mill Branch as a drainage channel.

The most extensive drainage project, as regards area covered, undertaken by the office during the year was that of Jefferson County, Tex., where 710,000 acres were surveyed. This large area of fertile land, consisting mostly of open prairie, is continuously wet owing to the absence of drainage outlets necessary to dispose of the heavy rainfall occurring in that section. The project was in charge of H. A. Kipp, assisted by A. G. Hall. The plan contemplates the organization of 35 separate drainage districts within the wet area, some of which will be drained by gravity systems and others by pumping. The improvements will consist mostly of the construction of new ditches, both mains and laterals, but considerable levee construction and some channel improvement will be included in the recommendations.

A drainage survey and plans for improvement were made for the proposed Pleasant Grove drainage district, Norfolk County, Va., by George M. Warren and N. B. Wade. The district contains 21,000 acres lying in the northeastern part of the Dismal Swamp. In those portions of the swamp where the timber has been cut the landowners now recognize that upon drainage and agricultural utilization must depend the future revenue from the lands.

RECLAMATION OF OVERFLOWED LANDS.

J. V. Phillips made plans for the prevention of overflow of Big and Little Curry Creeks on the land of L. G. Hardman in Jackson County, Ga. The proposed work would protect from overflow about 100 acres.

A survey was made of Big Haynes Creek, Gwinnett County, Ga., by J. V. Phillips. The recommended plan of improvement consists of opening up the present inefficient creek channel, thus enabling 618 acres of now useless bottom land to be put under cultivation.

The overflow of Buffalo Creek and its tributaries in Cleveland County, N. C., has caused considerable loss in the past and has prevented continuous cultivation of the adjoining bottoms. Plans were made by F. G. Eason which, if carried out, will reduce but not wholly prevent damage by overflow to 2,100 acres of bottom land, and especially will improve the health conditions of the district.

C. W. Mengel made a drainage survey of Little Sugar Creek, a tributary of the Catawba River, in Mecklenburg County, N. C. This creek winds through bottom lands of irregular width, which while being very fertile are subject to frequent overflow. The prevalence of wet conditions has also had an injurious effect upon the health conditions of the neighborhood. The drainage plans submitted by the office should, if carried out, result in great benefit to the community.

DRAINAGE OF IRRIGATED LANDS.

Investigations of seeped and alkaliied conditions on irrigated lands of Colorado were carried on by D. G. Miller, who examined numerous damaged tracts in the San Luis and Grand River Valleys and made recommendations for the relief from existing conditions.

In June, 1911, W. G. Sloan was assigned to the State of Idaho as the representative of drainage investigations. Some time was spent in becoming familiar with drainage conditions of the State. A survey was made for a system to drain 310 acres of commercial apple orchard belonging to the Stephens Orchard Co., near Nampa. In connection with this project extensive studies were made of ground-water movement. In the Payette Valley a cooperative experiment in drainage was begun on the 40-acre farm of C. F. Eder, near New Plymouth. Numerous other surveys and examinations were made on tracts varying from 10 to 300 acres in extent.

The work in New Mexico was in charge of Sidney W. Cooper. Considerable time was devoted by Mr. Cooper to assisting in the preparation of the New Mexico drainage district law, and in helping in the organization of drainage districts. Profiles and lines of test holes were run across the Pecos Valley, and a map prepared showing the classification of the lands of the valley with regard to their need of drainage. Mr. Cooper superintended the construction of drains through quicksand on the land owned by Williams and Jackson at Artesia, and made various trips through the Rio Grande and Pecos Valleys, studying conditions and assisting landowners in the drainage of their lands.

W. N. Hall has represented drainage investigations in the Texas field since May, 1911. Mr. Hall has been occupied during the year with a large number of projects of various sizes in the lower Rio Grande Valley. For some of these undertakings plans were fur-

nished, while in other cases recommendations were made following merely personal inspections of the injured areas. Some experiments were carried on in the use of explosives in ditch construction, and some observations were made as to the efficiency of windmills for pumping drainage water.

A large number of seeped and alkali tracts in various parts of the State of Utah were examined by R. A. Hart. Among the principal ones on which detailed studies were made and recommendations submitted were the following: The W. E. Bassett tract, Clearfield; the Earl-Ross project at Lehi; the Knight tract at Clearfield; the Lehi conservation project at Lehi; tracts Nos. 1 and 2 at Smithfield; and Storr Bros. tract at American Fork.

The extreme northwestern field is covered by W. W. Weir, with headquarters at North Yakima, Wash. In addition to investigations made and assistance rendered on numerous small tracts in this section, Mr. Weir assisted in the completion of drainage plans and specifications for the Moxee Valley project, in the organization of drainage districts at Granger and Dugualla Bay, and in the installation of drainage systems for the McPhee-Thomson ranches in the Naches Valley, all in the State of Washington. He also acted in an advisory capacity in the preparation of plans and the making of assessments for the Umatilla drainage district in Oregon, by virtue of which 1,500 acres on the Umatilla River have been successfully drained.

In Wyoming W. A. Kelly made a survey and drainage plans for the Lovell drainage district, a district organized in 1911 in the Shoshone Valley and containing approximately 2,800 acres. Final surveys were made for the Bench Canal drainage district in the Big Horn Basin and about 18 miles of drains laid out. Several other surveys and examinations were made on various sized tracts in different parts of Wyoming and Montana for the purpose of providing relief from seepage and alkali conditions. Some of this work has been carried out, resulting in great benefit to the land.

PRELIMINARY EXAMINATIONS AND RECONNOISSANCE.

Some of the more important preliminary examinations made during the past year were as follows: Alabama: Big Swamp (Lowndes County), Caleebee Creek (Macon County), wet prairie lands. Florida: Proposed Cedar Lake drainage district (Jackson County). Georgia: Appalachee River (Gwinnett County), Little Satilla River and Red Cap Swamp (Camden and Glynn Counties). Idaho: Mason Creek (Canyon County). Illinois: South Branch of Rock River (Rock Island County). Kentucky: Wet and overflowed land (Jefferson County). Maryland: Dennis Bros. Lumber Co. tract (Worcester County), Dublin Swamp (Somerset County), Marumsco Tax Ditch

(Somerset County). Massachusetts: Salt-marsh land (Plymouth County). Mississippi: Lappatubba and Oconitahatchie Creeks (Union County), State farm (Sunflower County), Tallahatchie River (Union County), Yocona River drainage district (Lafayette County). Missouri: Locust Creek Valley. North Carolina: Maxwell Creek (Duplin County), Richland Township (Beaufort County), Upper Little River (Harnett County). Oklahoma: Bitter Creek and Duck Creek (Kay County). South Carolina: Black and Boggy Swamps drainage district (Hampton County), proposed Broad Swamp drainage district (Williamsburg County), proposed Fishing Creek drainage district (York County). Texas: A. W. Gray tract (near Brownsville), Jefferson County. Utah: Earl-Ross project (Utah County). Virginia: Pleasant Grove magisterial district (Norfolk County).

TECHNICAL INVESTIGATIONS.

The special run-off investigations started last year were completed. These were carried on by various engineers in southeast Missouri, southeast Arkansas, western Mississippi, and southern Louisiana. A bulletin is now in preparation which will contain a complete summary of these investigations and a discussion of the subject of run-off in general. C. W. Okey continued his study of the wet prairie lands of southern Louisiana. The work included among other features a study of the drainage properties of the soil, the best practice as regards that particular section in the design, arrangement, and construction of levees and ditches, the most economical relation between reservoir and pumping plant capacities, the most advantageous size of reclamation district, and the selection and arrangement of pumping machinery. Although this line of investigation is not completed, a bulletin upon the drainage of the wet lands of southern Louisiana was prepared which contains the results of the work to date.

DISSEMINATION OF INFORMATION.

Only a limited number of reports upon the most representative drainage projects are published for a large distribution. However, copies of all drainage reports made by the office are available in typewritten form to a limited number of persons interested in any particular undertaking or in the general subject of drainage. In addition to the large number of typewritten reports distributed, and the extensive correspondence on drainage practice carried on, the office issued in printed form during the year reports on tidal marshes and their reclamation; land drainage by means of pumps; the Belzoni drainage district, Washington County, Miss.; the Back Swamp and Jacob Swamp drainage district, Robeson County, N. C., and drainage of the wet lands of Effingham County, Ga.

PROMOTION OF AGRICULTURAL EDUCATION.

The methods of every generation are an outgrowth or development from preceding generations. Some of the best from every generation is preserved, modified, and developed to meet the changing needs and new conditions. In this forward march in agricultural education, as in other forms of education, there has always been some back tracking, some mistaken notions as to what is best to preserve, but the general trend is forward in the solution of the problems of the farm, the school, and the home. There is no longer any question as to who shall assume the responsibility and expense of furnishing for the farming class an education which bears some relation to their prospective life work, as does the college education and the life work of the professional classes. This is especially apparent this year in the better support given to the agricultural colleges in the establishment of additional agricultural courses in universities and colleges of private foundation, in the increasing number of States giving financial aid to secondary instruction in agriculture, in the attention given to the training of teachers of agriculture for secondary and elementary schools, in the larger attendance of students at all sorts of colleges and schools in which agriculture is well taught, and in the great popularity of certain forms of elementary instruction in agriculture, such as children's gardens in cities, boys' corn clubs, girls' garden and canning clubs, and other juvenile agricultural club work.

Data compiled by this office bring out some very important facts concerning the rapid development of college and school courses in agriculture in the United States since the publication of similar data in 1910. In this interval of less than two years the total number of institutions of all kinds reporting students in agriculture has almost trebled. The number of privately endowed colleges offering courses in agriculture increased from 24 to 42. Columbia University has established short courses and extension work in agriculture, and Syracuse University has added divisions of agriculture and forestry. Almost all the State colleges for women in the South now maintain courses in agriculture, giving attention particularly to gardening, floriculture, and poultry husbandry.

Agricultural schools of secondary grade have increased in number and many public schools have inaugurated courses in agriculture, home economics, and manual training. There are 78 special agricultural schools as compared with 58 in 1910, and 289 public high schools receiving State aid for courses in agriculture, whereas in 1910 there were 28. Minnesota alone is giving \$125,000 a year to stimulate the introduction of agriculture, home economics, and farm mechanics into public high schools, 30 of these schools receiving \$2,500 a year each and 50 schools receiving \$1,000 each. Kansas, Louisiana,

Maine, Maryland, Massachusetts, New York, North Carolina, Virginia, Texas, and Wisconsin are the other States that appropriate funds for this purpose.

In 1910 there were only 432 of the unaided high school departments of agriculture, a little more than one-fourth of the present number. The number of State and county normal schools which are giving their students some instruction in agriculture has increased from 156 to 196.

Increased attention has been given to the promotion of the elementary phases of instruction in agriculture. The enrollment in boys' and girls' agricultural clubs in the South increased from 46,000 in 1911 to about 60,000 in 1912. There has been a corresponding growth of this movement in other parts of the country.

Through the agricultural education service of the Office of Experiment Stations the United States Department of Agriculture in an advisory capacity continued to aid the State officials in the promotion of agricultural education. This service was continued under the immediate direction of D. J. Crosby and in accordance with the clause of the appropriation act of the department which authorizes "the Secretary of Agriculture to investigate and report upon the organization and progress of farmers' institutes and agricultural schools in the several States and Territories, and upon similar organizations in foreign countries, with special suggestions of plans and methods for making such organizations more effective for the dissemination of the results of the work of the Department of Agriculture and the agricultural experiment stations, and of improved methods of agricultural practice." The demands upon this branch of the office for assistance to colleges and schools of different grades and to teachers and other school officers interested in the promotion of agricultural education have continued to grow more rapidly than the funds for the work have increased, and consequently the facilities of the office for assistance to these educational agencies have not enabled it to keep up with the demands. The detailed report of the specialist in agricultural education will be found on pages 279-332.

The director of the office continued as dean of the Graduate School of Agriculture, as bibliographer of the Association of American Agricultural Colleges and Experiment Stations, and as chairman of its committee on instruction in agriculture.

FARMERS' INSTITUTES AND EXTENSION WORK.

Work relating to farmers' institutes and agricultural extension was continued along the same lines as in previous years under the direction of the farmers' institute specialist, John Hamilton, and his assistant, J. M. Stedman.

Data respecting farmers' institutes and other forms of extension work, both in this country and abroad, were gathered and arranged for publication. Addresses were delivered before farmers' associations and at educational institutions. The proceedings of the American Association of Farmers' Institute Workers, of which the farmers' institute specialist is secretary, was edited and published. There were also issued the annual report of the farmers' institute specialist; illustrated lectures on farm homes, farm home grounds, and peanut culture; a revision of the list of farmers' institute directors and lecturers; and a bulletin giving a course in the use and preparation of vegetable foods for movable schools of agriculture. There was a marked increase in the distribution of printed information and in correspondence.

A large number of officials connected with farmers' institutes, extension departments in the agricultural colleges, fair associations, State libraries, railroad agricultural extension departments, State departments of agriculture, and other institutions and associations interested in agricultural extension work were visited and interviewed.

The detailed report given on pages 333-383 shows that there was great activity during the year in various forms of extension work. Special effort was made to develop some of the forms of extension work that are now in operation, to introduce new methods for use by State officials and college extension directors in disseminating agricultural information and in itinerant instruction work, and to aid in the proper organization of extension work as an integral part of the agricultural educational system of the country. With this purpose in view the office began the issuing of courses of study adapted to correspondence teaching with detailed instructions for conducting this method of extension. Investigations were conducted to ascertain the effect of extension teaching upon agricultural people and to secure data relative to the improvement of plans for buildings and grounds for local and State fair associations.

PUBLICATIONS.

The office issued during the year 85 documents, aggregating 4,761 pages, including 18 numbers of Experiment Station Record, 2 reports, 10 technical bulletins, 5 circulars, 8 Farmers' Bulletins (6 of which were numbers of Experiment Station Work), 5 consecutively paged numbers of Experiment Station Work, 3 farmers' institute lecturers, 8 publications of the insular stations, 3 Yearbook articles, 11 monthly lists of station publications, and 12 separates from the annual report of the office for 1910. The number of new publications, excluding revised reprints and separates, was 66, containing about 4,000 pages, as compared with 80 containing about 4,700 pages the preceding year. These publications, as in previous years, (1) reviewed the

progress of agricultural education and research throughout the world, and (2) reported the results of special investigations in nutrition, irrigation, drainage, and agricultural education. There was little change in their general character.

The general editorial work on these publications, exclusive of Experiment Station Record, was as heretofore in charge of W. H. Beal.

INCOME.

The income of the office during the past fiscal year was as follows:

Appropriations by Congress:

For the general expenses of the office.....	\$94,000.00
For the Alaska experiment stations.....	30,000.00
For the Hawaii Experiment Station.....	30,000.00
For the Porto Rico Experiment Station.....	30,000.00
For the Guam Experiment Station.....	15,000.00
For investigations on agricultural schools and farmers' institutes.....	10,000.00
For nutrition investigations.....	15,000.00
For irrigation investigations.....	100,000.00
For drainage investigations.....	100,000.00
Total.....	<u>424,000.00</u>

Sale of agricultural products at the insular experiment stations:

Alaska experiment stations.....	2,882.47
Hawaii Experiment Station.....	459.35
Porto Rico Experiment Station.....	4,927.80
Guam Experiment Station.....	34.00
Total.....	<u>8,303.62</u>

Total income..... 432,303.62

WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS.

By E. W. ALLEN and J. I. SCHULTE.

REVIEW OF THE YEAR.

The beginning of a national system of agricultural experiment stations in the United States dates from 1887, when a bill introduced by Hon. William H. Hatch, of Missouri, was passed by Congress and became effective. The year 1912, therefore, marked the completion of a quarter century of operation under this act. The anniversary was celebrated, in connection with the fiftieth anniversary of the establishment of agricultural colleges and of the Federal Department of Agriculture, at the annual convention of the Association of American Agricultural Colleges and Experiment Stations at Atlanta in November, 1912.

The year was one of marked prosperity and progress at the experiment stations. There was a notable improvement in the general character of the work conducted and in the organization of the departments and adjustment of duties so as to permit larger freedom for uninterrupted investigation by the men who are primarily station employées.

There were many improvements in facilities for the station work in the shape of specially designed buildings, laboratory equipment, and apparatus. As examples may be mentioned special facilities for slaughtering animals and the handling of the carcasses preparatory to analysis in the new building for agricultural chemistry at the Missouri university and station, improved facilities for the milling of grains and the testing of flour in the new agricultural building in Kansas, and the construction of an extensive and elaborate outdoor laboratory at the Colorado college and station for the study of problems in hydraulics as related to irrigation. Such facilities have grown out of the experience and the necessities of the station work, and in many cases are an important original contribution to the methods of investigation.

In California a new dean and director was appointed at the close of the year and a program outlined for large extension and development of the work of experimentation in different parts of the State. In Arkansas the station was embarrassed in the conduct of the substations previously established by the State by a division of the appropriation. This necessitated reducing the number of substations

and left only a small amount for the conduct of work at those remaining. The Texas station nearly completed its system of branch stations and made marked progress in organizing these and laying out their work. Provision was made for a system of branch stations in Kentucky, and farms for new stations were acquired in Nebraska and South Carolina. In many other States facilities have been provided for conducting experiments and investigations in different sections of the State, either by purchase, lease, or the donation of lands. This enables the study of problems of special local importance under conditions within the control of the station.

In the conduct of the stations there has been a further differentiation of the work of experimentation and investigation from that of extension enterprises. But there still remains room for improvement in this direction. The number of bulletins prepared by station workers which are not based primarily on first-hand information and the extent to which members of the station staff continue to take part in institute work, educational trains, exhibitions, demonstration experiments, and other lines of activity essentially extension in their character is still a source of embarrassment to the station work.

The office has consistently held that Federal funds can not be properly used to pay for such publications or for the time of men employed in extension work. But this does not fully counterbalance the effect of such activity on the part of the station staff, which diverts attention, interrupts the continuity of investigation, continues to propagate a wrong idea as to the function of the station, and prevents a natural segregation of those whose taste and ability lie along the lines of extension teaching rather than investigation.

Considerable attention has been given to the matter of station publications and their mailing. An increasing number of the stations have established a technical or research series of bulletins as a means of reporting the details of special studies which are not of interest to the general public but mainly to workers in other stations and students of science generally. Since these results constitute one of the most valuable products of the station's activity, they deserve to be published as a record of investigation and placed at the disposal of such persons as will be interested in and will profit by them. Inclusion of such technical details in the regular bulletin series fails to accomplish the desired purpose, and often leads to criticism and misunderstanding. In the absence of any organ for recording the progress of agricultural science this technical series has become a practical necessity. Many of the investigations reported are a product of the Adams fund, and the number of investigations under this fund which are coming to completion is now quite large. Some of these will yield results which should also be given in abbreviated and less technical form in the regular series of bulletins.

The office has urged that the bulletins of the regular series should find their basis primarily in the work of the station. While these bulletins may also include such general discussion of the subject treated as is desirable to an understanding of what the station has added and its bearings, a few general observations or simple tests should not furnish the warrant for a general bulletin made up mainly from common sources of information. Not infrequently such fragmentary new work is so intermixed with common information that it is impossible for the casual reader or even the student to determine what, if anything, the station has actually contributed to the subject. The station thus fails to receive credit for its work, and if the bulletin is assigned to the Federal fund it invites question as to whether the charge is appropriate.

The office has drawn the line closer and closer on such publications and has insisted that where claims for originality are made the matter must be so set forth that it will stand out as a product of the station's work, rather than be lost in generalities, and be sufficient in quantity to furnish a real contribution to the subject. Nothing will do more to secure credit for the work or the publications of the experiment stations; and until a sharper distinction is drawn which will eliminate the extension bulletin from the regular station series the station publications will not attain the rank they should in the literature of agricultural science, and the authors will be ranked by many as compilers rather than producers of agricultural information.

Attention has also been called by the office to the failure on the part of a number of stations to issue an annual report of progress, such as is prescribed by the Hatch Act. It has pointed out that this is not only a requirement of the Hatch Act but a general requirement of good administration. The public has a right to expect it from a public institution, and it has a historical value as showing the progress of the station in important matters from year to year. On the other hand, as a leading public institution each station is entitled to a public record, a means of recording for its own benefit, as well as for the State and the student, the service it has rendered to the public welfare and the return it has made for the funds intrusted to it.

In a number of cases the annual report has degenerated into the briefest possible mention of the lines of work and the summarized expenditures, which furnish little real information and can have but little interest. There is so much of interest in the operations of a station from year to year that an annual review or résumé may be made readable and instructive, without going into lengthy details, and enable the busy man, the State official, or the legislator to gain an intelligent and quite comprehensive view of the field which the station is covering and its general progress.

A considerable number of the stations are simplifying the mailing of their bulletins and classifying their mailing lists to avoid waste in distributing their publications. The mailing lists have quite generally been put on stencils, where they are large, and mailing machines are employed to economize labor. Where the mailing lists are classified, the subjects in which the individuals are interested are ascertained by correspondence—whether horticulture, or animal feeding, or dairying, or forestry, etc., and such persons are not sent bulletins in lines in which they have no interest. Such a classification by subjects has been recommended by the committee on station organization and policy of the Association of American Agricultural Colleges and Experiment Stations.

Greater provision has recently been made for the stations to conduct work in different regions of the States, away from the headquarters, wherever the problem may lead. The general principle followed in such cases is that the station must have absolute control of the land and crops, and to this end the land is leased or purchased. The location of branch stations on a geographical basis is very generally condemned, as not being necessary and rarely meeting the special requirements of the station. The station should follow the problem where it leads, and locate its branch station at a point which will be most advantageous for its study. The attempt to make these branch or substations anything more than special stations for the study of particular problems which led to their establishment is generally discouraged. Duplication of equipment and the incurring of heavy maintenance charges are to be avoided as far as possible; and the substations, whether temporary or permanent, should be field laboratories or extensions of the facilities of the central station. The work done there should be planned by the experts at the central station and thoroughly directed and controlled by them.

ANNIVERSARY OF THE EXPERIMENT STATIONS.

The quarter century which has passed since the establishment of the national system of experiment stations in this country has been a remarkable period of development. More progress has been made in an intelligent understanding of the great industry of agriculture and in the improvement of its methods than in the centuries that have gone before. Out of the passage of the Hatch Act has grown the most comprehensive and efficient system of experiment stations to be found in any country—one which has been close to the problems of the people, has revolutionized practice in many important respects and provided notable improvements in others, and has laid a broad foundation for a science of agriculture.

To-day nearly everyone recognizes the power of science and its practical application to the affairs of life. The common laborer on the farm believes in its possibilities as related to agriculture, just as the manufacturer, the man of large business interests, and the house-keeper look to science to guide them and suggest a rational and intelligent course of action by disclosing the reason for it. In a few short years there has been a remarkable change in the popular attitude toward scientific investigation. Instead of being something for the pursuit and understanding of the few it is seen to be intensely human, and science in the service of mankind has become a watch-word of progress. Some of its most striking and widely heralded illustrations have come through agriculture, and have probably done more than investigations in any other field to popularize science. This development of an attitude of confidence and appreciation and a deeper understanding of the applications of science is one of the greatest products of these institutions.

Nowhere has the change been more striking than in the Western States. To the pioneer farmer the new experiment station was an object of scant interest, if not of ridicule and contempt. With the primitive and crude methods there followed, it was difficult to see that such an institution was needed or could be of any service to the ranchers or stockmen. But the pioneer conditions soon changed with the settling of the country, the following of more intensive methods, the necessity for economizing the water supplies, and the introduction and culture of crops not native to the section. With his characteristic enthusiasm and progressiveness the western farmer has quickly learned to use his experiment station and has been ready to embrace its teachings, because, fortunately, he was not bound down by tradition and had an open and receptive mind. To-day the new settler looks to the experiment station for guidance, for he soon learns that his experience in other sections is not a safe guide, and the old settler drives a hundred miles across the plains to the experiment station to learn the cause of his failure to make alfalfa grow, or leaves his home for a week's short course. The transformation has indeed been a great one.

RELATION OF STATION AND EXTENSION WORK.

No one familiar with the conditions will doubt that the establishment of a national system of experiment stations has proved one of the most important and far-reaching steps which this country has ever taken for the advancement of an industry. The breadth of agriculture as we now understand it, and its manifold relations to commerce and industry and to the affairs of man, magnifies the significance of this step.

But the demands of the public for advice and for assistance along many lines which reach over into the field of instruction has outgrown the experiment stations, and resulted in the creation of a new arm of the agricultural service. The necessity for differentiation between the work of acquiring and diffusing information has become clear. A beginning has been made in this direction, but the proper relation which the experiment station and its workers should bear to the new department of extension is one of the most important problems now affecting these institutions.

It is becoming generally recognized that these lines of work are sufficiently distinct and extensive to need special provision for their administration, and to a large extent separate staffs. This is shown by the fact that some form of organization for extension work has been provided in 43 States, and that in all of these cases extension directors have been appointed and placed in charge. Of these directors, only eight are also directors of the experiment stations, which indicates the prevailing tendency to place extension teaching on an independent footing and separate it from the experiment station work proper.

This office continues to favor the arrangement by which the activities of the agricultural college are grouped and differentiated under three heads—namely, research, interior teaching, and extension. The research work is the field of the experiment station, the interior teaching is done by the faculty at the college, and the extension work is the field of the extension division. The uniting of this new extension department with the other work of instruction so as to become an organic part of it, and representative of the instruction given by the college and of the researches by the experiment station, is most important.

The work of the college as a whole should naturally be divided according to the subject matter into departments, such as those of agronomy, animal husbandry, dairying, horticulture, etc. Since it is highly important that the information on any subject given to the student and the public should represent the views of the institution as a whole, all the experimenters, teachers, and extension workers should be grouped by departments. Thus the department of agronomy should embrace all the agronomists employed by the college, whether they are engaged in experimenting, teaching, or extension work.

Each department will naturally be presided over by a head professor, who will have authority to assemble all workers in his line for consultation regarding the subject matter of their work, methods of instruction, etc. All the workers will be expected to keep in close touch with their respective departments, so as to be fully acquainted with their work and the progress of knowledge in those lines. On

the other hand, each member of a department will be a member of the experiment station, the college instruction force, or the extension division, and in some cases will take part in the work of more than one branch. He will be under the control of the director of the division to which he is attached, who will supervise his duties as experimenter, teacher, or extension worker.

Such an organization is in accordance with the experience thus far had in the organization of extension work. It is very desirable that as far as possible the individual shall devote himself primarily and chiefly to one line of work, and as the extension work increases it will be necessary more and more to have men working exclusively in that department. This is already true with regard to the experiment station. Under this arrangement the investigator will be freed from the burden of giving general agricultural instruction, in the college or to the agricultural public, but he will not be prevented from giving an occasional lecture, if he be so inclined and his other duties permit.

To carry out such an organization several classes of administrative officers are required. The college of agriculture, including its research, interior teaching, and extension work, will be in charge of a dean. Under this dean will be three directors, (1) of the experiment station, (2) teaching division, and (3) extension division. Each of these directors will have administrative control of his division and of the men assigned to it as far as the program for the employment of their time and assignment to duties is concerned. Where the work and staffs of the divisions overlap or cooperation is desirable, the three directors should form an administrative committee under the chairmanship of the dean.

The present popularity of extension work and its rapid growth requires much care in the making of plans for it and in its adjustment to the work of the other branches of the college, especially the experiment station. The station work must not be overshadowed by it nor suffer from the appreciation of the extension enterprises. The frequent definition of the functions of these two departments—that the experiment station is for the acquisition of new knowledge and the extension service for dissemination—is not to be construed too literally or narrowly. It remains the function of the experiment station not only to make new discoveries and suggestions, but to test the application and the practice of its theories or findings until these have been established beyond reasonable doubt. But after the work has passed the experimental stage and has been presented to the public in popular as well as technical form, the problem is to demonstrate and explain it to those who have not been reached and to point the way for its introduction into their practice. It then becomes a matter for the extension department.

The station need not be out of touch with the farmers and their special problems where these present anything new; its field is not restricted to the purely theoretical side. It would be a sad mistake for the station worker to withdraw within his laboratory and devote himself to abstruse studies that are prompted by interest in science rather than in agriculture. It would tend to fossilize the worker, as that attitude has workers in other countries and other lines, and rob his work of its direct value. His work must be vitalized, and he must retain the same interest in its relation to practical affairs that he does now. The way to accomplish this is one of the matters to be worked out in adjusting this new service, and this is a function of the dean. He will have many adjustments to make between the directors of the different groups, and it will fall to him to maintain the right balance or relationship between the station and the extension work.

But the experiment station is not to be the agency for the dissemination and demonstration of elementary general information and practices which rest on common knowledge, or for conducting a campaign for better agriculture or reform in practice, or for giving advice drawn from the literature and from practical experience, or the introduction of new branches of industry, or interesting the farmers' children through competitions, or the general improvement of country living. Some of these things are in the field of the new department; with its coming they have passed out from the field of the station.

In its teachings the extension staff should take pains to give the experiment station credit for its work. This should be insisted upon by the administration in the interest of justice and in order that the public may maintain the right perspective as to the various agencies. The station must continue to be relied upon as the main source of new and tested information, and be appreciated as essential to the continued progress of agriculture in order that its needs may be provided for.

Farmers do not discriminate between what is new to them and what is original or new to the world, and the man who by a demonstration or otherwise discloses a new fact to them is likely to be credited with its origination. This is largely inevitable. The station man must recognize it, as long as liberality and fairness is shown him, and must look for his main satisfaction and credit to his colleagues the world over and to the more enlightened people who realize the basic character of his work.

We look to the physician to determine what is the matter when we are sick and to prescribe a remedy—either medicine or treatment or change. We have confidence in his knowledge and judgment to do this, but the more enlightened people know that beyond his experience he is rarely the source of this knowledge, and do not

credit him with being a discoverer. They know that he would make little progress except for those behind him who are conducting the fundamental studies which he has no time for and usually not the equipment or ability to carry out.

It is much the same with the extension worker. He combines a knowledge of the practical and theoretical as applied to the region he works in, and the ability to use and impart this in giving practical advice and instruction. Like the physician, he draws his stock in trade from two sources—the investigator and the successful practitioner—and to this he adds his own experience and judgment. The teachers in the classroom are rarely the authors of the information they expound, and the setting forth of the origin of important theories and discoveries, where these can be definitely determined, often forms a part of the subject matter they teach. Such credit is not only due the experiment-station worker, and especially those of the institution with which the extension work is connected, but it is often a matter of interest to the farmers, and particularly in publications and correspondence it is easily arranged for.

The extension worker would have lasted but a short time 25 years ago, before the experiment stations came, even if the public had demanded him, for the information which enables his work to be successful and vital was not at hand. The experiment stations and similar agencies have supplied it, and they will continue to supply it, and it will form the mainstay of the extension worker. He will not be an investigator himself, for he will not have the time and rarely the ability or faculty for it; but he will be a keen observer, will be quick to see the application of the station's results, and will interpret its findings in terms of farm practice.

A good deal is said about the collation of personal experience of farmers and the reliability of generalizations drawn from large numbers of successful examples. Interesting and valuable as is the experience of successful farmers, and much as it needs to be taken account of, its interpretation requires the same study and discrimination that scientific investigation does. There are usually a larger number of elements involved than in an experiment, and among these the personal element and the local and economic conditions figure largely, all of which are variable and more or less transitory. There are distinct limits to the application of information from this source. Taken alone, it is far from being a safe basis for extension teaching, and can not take the place of the carefully controlled and interpreted studies of the experiment station.

Success in farming is largely an individual product. The individual can only partially be divorced from it. Examples of success are useful for illustration and in helping to work out efficient methods of management, but the conditions entering into these cases must

be weighed and studied with much care before generalizations are safely drawn from them. Deductions from individual examples are likely to be misleading when transplanted to another set of conditions, and broad generalizations on this basis are unsafe except in the hands of experts dealing with large amounts of data.

There is nothing sensational or novel in the fact that farmers are discovered who have developed exceptionally good methods of practice, the reason for which we can not yet fully explain. It merely shows that, as in most of the older industries, the art has preceded the science. Men knew how to make metal implements and vessels and articles of pottery and to employ cement long before chemistry became a science or was applied to these industries. We marvel at the result of manual dexterity as exemplified in some of the arts of ancient or primitive peoples. These industries, including agriculture, developed without science, out of human experience and the example of many generations. Their methods and the supposition concerning them are wholly empirical, and often fall to pieces when subjected to scientific test and analysis.

Human experience is useful only when rightly interpreted. Moon farming was developed out of it, and many other theories which have long been a bar to progress. Time was when experience was man's only guide, and he advanced but slowly. The ability to call science into the service of agriculture is a very modern accomplishment. But there is no reason why we should now abandon it and return to experience except in the hope that a short cut will be found, an expectation which is not shown to be well founded.

One great element in the recent rapid progress of agriculture has been the fact that it has been based on scientific fact, which has been tested and demonstrated and made intelligible by disclosing the reason underlying it. It has replaced tradition and supposition as well as undigested and misinterpreted experience. Until the reasons underlying the practices in successful farming are known, men remain blind imitators of a once successful experience. They are so tied down by a lack of knowledge as to the relation between cause and effect that there is little freedom for the exercise of judgment. Under such circumstances intelligence and understanding can not be developed.

There is a relatively large fund of information on better and more efficient farming which has not yet reached the rank and file of farmers. This can be taught them through extension methods, but to a very large extent the extension work must deal with and be guided by principles, and for the development and elucidation of these it must look to the experiment stations and similar agencies. Only to a limited extent can it aid the individual with definite rules and advice. Even if it could it would not do him the most good, for

farming can not be conducted according to fixed rules. The whole aim of agricultural teaching is to get away from rule-of-thumb methods and to substitute in their place a larger degree of intelligence and understanding. The extension movement may do more harm than good if the farmer is thereby made to believe that the Government can make a set program for agricultural practice and that he has only to follow the advice given in publications or by itinerant lecturers and teachers. The spirit of initiative, self-help, and cooperation among farming people should be conserved and broadened, and the danger of leading them to lean too heavily on the National and State Governments should be guarded against.

American agriculture is just now passing out of its crude pioneer stage. It will become more and more a complicated and technical industry, in the prosecution of which broader and more exact knowledge, sounder judgment, and larger business ability will be required for success. The deeper and more permanent purpose of extension teaching is to enable the farmer to help himself to become more resourceful, to give him a broader intelligence and more reliable judgment, so that he will be able to take new information that comes to him from whatever source and apply it effectively. As has been said, "science is alike to all men who have grasped its data and its conclusions; art will vary with the personality of the individual who practices it."

We are now in a transition stage. Many station men cling to activities which are in reality extension work, because they are uncertain as to the future support of the station work and the position the station force will ultimately occupy. If they have the real spirit for investigation they should be encouraged to concentrate their efforts more largely upon it, so that the wellspring of knowledge may not be choked or hampered or allowed to run dry. They will find their reward in the commendation of their coworkers and in the satisfaction of accomplishment, quite as well as in the plaudits of the people. The productive station worker will not long lack public appreciation. Well-informed farmers will not fail to appreciate publications which present new facts and methods instead of general information with which they are already familiar. The public will learn the place of extension teaching, and with full appreciation of its great value will not fail to realize that it does not meet all the requirements, but must depend for success on the maintenance of efficient experiment stations. The adjustment may take a few years, but in the meantime administrative officers should see to it that the stations are given a clear field and do not suffer. They are entitled to strong support by the institutions with which they are connected, and there should be no doubt in the minds of the public that they are receiving such support.

INCREASE IN FUNDS AND EQUIPMENT.

For the fiscal year ended June 30, 1912, the appropriations received by the stations under the acts of Congress amounted to \$1,545,000. The work of the stations during the past year was aided by State appropriations to the extent of \$1,492,798.12 and the Federal and State funds were supplemented by fees, contributions, and amounts realized from the sale of farm products and other sources aggregating \$1,135,441.97. The total of the funds at the disposal of the experiment stations during the year was \$4,068,240.09. Among the increases in funds and equipment for the year the following are of interest.

The State appropriation of the Alabama canebrake station was increased from \$2,500 to \$4,000 per annum.

The first State Legislature of Arizona greatly increased the State appropriations in favor of the experiment station by granting \$18,000 for work in dry farming, date culture, horticulture, farmers' institutes, and for publications and miscellaneous expenditures.

The General Assembly of Colorado appropriated \$10,000 for general station and extension work.

The Indiana station began the construction of a substantial brick building to replace the seed house destroyed by a storm last year, and also erected at a cost of \$12,000 a building for use in connection with the production of hog-cholera serum.

At the Kentucky station the construction of an addition to the present station building to cost \$50,000 was begun. The chemical laboratories and the bacteriological food and feeding stuffs work will be located in the new portion when completed. The legislature granted a permanent appropriation of \$50,000 per annum for the use of the station in experimental work with soils, horticulture, breeding and feeding live stock, dairying, and poultry husbandry, for extension work, for enlarging and operating the hog-cholera serum plant, and for general maintenance.

The Maryland Legislature appropriated \$3,000 for each of the years 1912 and 1913 for demonstration work, the amount being equally divided between demonstration in dairying, horticulture, and crop and fertilizer work. Provision was also made for establishing at the station, through the State board of agriculture, a State biological laboratory for the manufacture of hog-cholera serum and other biological preparations for domestic animals, and for conducting investigations. The law provides that hog-cholera serum be sold to farmers at cost and be administered under the station direction. For 1913 \$10,000 and for 1914 \$5,000 was appropriated, and the director of the station was made director of the laboratory.

A bureau of research in agricultural economics was organized at the Minnesota station during the year and studies with reference to

marketing farm produce, agricultural cooperation, types of agricultural organizations, agricultural credit, and kindred subjects are to be taken up. The station also began the establishment of a poultry section and planned buildings and grounds for its use. A new hog house along most modern lines was constructed during the year.

At the Mississippi station a new hog barn 30 by 100 feet with concrete floor, dipping vat, and all modern fixtures was built at a cost of \$2,500.

The Missouri station built a seed and fertilizer house at a cost of \$1,500, infection pens for hog-cholera work for \$2,000, and poultry buildings at a cost of \$2,500.

General improvement in equipment was made at the Montana station in the way of constructing several minor buildings and a concrete silo 16 by 33 feet, at an outlay of \$4,000.

At the Nebraska station a fireproof building for agriculture, botany, horticulture, and entomology was erected at a cost of \$85,000. A dairy shed for experimental and other work was erected during the year at a cost of \$2,000. At the North Platte substation a house was built at a cost of \$8,000, at the Culbertson substation a dwelling and machine shed at a cost of \$3,000, and at the Scotts Bluff station a dwelling house at a cost of \$1,400. There was also a State allowance of \$7,500 for hog-cholera serum work and \$5,000 for entomological inspection.

The State appropriations for the New Jersey stations included \$18,000 for buildings and equipment in the department of poultry husbandry, \$20,000 for the construction and equipment of greenhouses for floricultural investigations, \$12,000 for buildings for dairy-husbandry work, and \$100,000 for the construction of an agricultural building that is to be used partly for experiment-station work. A tract of 135 acres of land adjoining the station farm was purchased for experiments in dairy husbandry and dairying.

The State appropriations for the Ohio station for 1912-13 included \$18,000 for work in agronomy, \$20,000 in animal husbandry, \$10,000 in botany, \$30,000 in cooperation, \$8,000 in entomology, \$12,000 in forestry, \$20,000 in soils, \$5,000 in chemistry, \$17,000 in horticulture, \$8,000 in nutrition, \$10,000 in dairying, and \$35,000 for administration. In addition to these direct appropriations the State furnished the station with printing paper to the value of about \$10,000. The poultry equipment of the station was extended by the construction of a laying house 24 by 100 feet and an incubator house 20 by 32 feet, with basement and brooder wing 15 by 80 feet. The emergency board of the State granted \$2,000 for the study by the station of a destructive cob rot of corn, which appeared in the western part of the State in the fall of 1911.

A stock farm of 115 acres just south of Corvallis purchased by the Oregon Agricultural College will be used by the station for all its stock-feeding experiments.

In South Dakota the State appropriated \$1,000 for testing some newly introduced Siberian plants.

The Texas station constructed a steam-heated greenhouse for winter studies of plant diseases and of the nitrogen-fixing bacteria of leguminous plants. A donation of \$1,000 per annum was made by a private party to the station for use in cotton breeding and improvement work.

SUBSTATIONS AND DEMONSTRATION FARMS.

In many States appropriations are made for the biennium, and since many legislatures met in 1911, the appropriations and authorizations for substations and demonstration work in 1912 were mentioned, to a certain extent, in last year's report. The progress made in this direction, and pertaining more particularly to the year under discussion, is here briefly summarized.

The governor of Guam ceded to the experiment station for its use a tract of about 130 acres of land adjoining that purchased in 1910. This tract represents a type of land of considerable extent on the island, and experiments carried out on it will be of wide application in Guam.

The Hawaii station, in cooperation with the Territorial authorities and private individuals, put into operation a number of demonstration farms on the islands of Hawaii, Maui, Kauai, and Oahu. On the island of Hawaii one of the stations gives special attention to dairying and forage crops, and near Hilo the culture of bananas and taro is studied. On Maui the substation devotes its energies to studying methods of tapping Ceara rubber trees, drying and curing rubber, determining the chemical composition of rubber, and growing intercrops between the trees. At the demonstration farm on Kauai efforts are devoted to growing pineapples, peaches, potatoes, onions, corn, and various leguminous and other plants. The Oahu substation is occupied primarily with experiments in dry farming, trials being carried on with leguminous plants, broom corn, potatoes, pineapples, and other crops.

The number of farms donated to the State of Illinois by individuals or communities for demonstration purposes was increased during the past year. These donations now number 19, aggregating over 400 acres and ranging from 15 to 30 acres each. In Dekalb County a soil improvement association was organized, and a guaranty fund of \$10,000 was raised among farmers, bankers, and other interests. The county board of supervisors contributed \$2,000 and authorized the use of the county farm where, as well as on private farms, field

demonstrations, mainly under the direction of the experiment station, will be established.

The Nebraska station purchased a 160-acre farm at Culbertson for demonstration purposes. A portion of the land will be used for dry farming work and the balance for cropping under irrigation.

In North Carolina a substation was established on the black or muck soils of the State, which cover an area of 2,500,000 to 3,000,000 acres and are being reclaimed by drainage. This substation will study the problems in connection with handling these soils and determining the crops best adapted to the conditions. A substation or test farm for experimental work with tobacco was established in the belt of the State where bright tobacco growing is a large industry of long standing. This farm is to be conducted in cooperation with this department and the line of work which has been in progress for several years is to be enlarged.

In Ohio a county experiment farm containing 216 acres was established in Hamilton County under a bond issue of \$40,000. An appropriation was made for the purchase of the Germantown test farm, and with the completion of this purchase the station will own 950 acres in the counties of Wayne, Cuyahoga, Meigs, and Montgomery, and will operate five additional farms containing a total of 581 acres.

Two demonstration farms in Crook County, Oreg., maintained by the county, the railroads, and commercial organizations, one for irrigation, the other for dry farming, were under the supervision of the department of agronomy of the Oregon station during the past year.

In order to facilitate the work of the Porto Rico Experiment Station, the insular government has set aside for the use of the station 200 acres of land about a mile from the present station site, and this is to be devoted largely to work in fruit growing.

A tract of 200 acres of land near Florence, S. C., was acquired at a cost of \$40,000 for use as a substation.

The Texas station was granted an appropriation of \$5,000 per annum and 550 acres of land for the establishment of a feeding and breeding substation.

NEED OF STATE APPROPRIATIONS.

The stations in a considerable number of States are seriously embarrassed by lack of funds and in great need of State appropriation to develop their work. While there has been increasing liberality on the part of most of the States, several of them have failed thus far to make any regular appropriation for the station, in spite of its growing needs and the closer restriction of the Federal funds. With the present active interest in agriculture and the popular appreciation of the experiment stations, the policy of withholding State aid

is difficult to understand, as it reflects directly on the agricultural industry of the State.

It was never expected that the Federal Government was to provide the sole support of these stations and entirely relieve the States from any responsibility in their maintenance. The rulings of the department have imposed numerous restrictions and limitations on the use of the Federal funds, and the requirements in all the States have outgrown these revenues. Where there are large agricultural interests to be aided by the station, the States should join with the Federal Government in the maintenance and development of these stations, and unless this is done the difficulties of meeting many necessary expenses will be increasingly acute.

The department takes the position that the Hatch fund, as well as the Adams fund, is for the carrying out of experimental and research work, and should not be absorbed in defraying general permanent and maintenance charges, such as the providing of buildings, pro rata charges by the college for heat, light, water, and power supplied out of its general revenues, expense for keeping the accounts of the station funds and the care of the library, expenses of the governing board, charges for janitor service and the care of grounds, maintenance expenses at the college farm, orchard, and greenhouse which the station uses on occasion, the salaries of members of the staff with whom station work is quite incidental to regular college duties, a large amount of general correspondence and consultation work which the station has not fully shaken off, the making of exhibits of various kinds, expenses of surveys, travel of a miscellaneous character not directly required by the station investigations, and similar expenses which are only quite incidental to the making of experiments and investigations. The station should, both in fairness and in view of the value of its work to the State, be largely relieved of these standing expenses and allowed to conserve its meager funds for the more direct purposes of productive investigation. The States should go at least that far in meeting the appropriations of the Federal Government.

An agricultural experiment station is an institution or department for conducting agricultural experiments and investigations and publishing the results of its findings, located in most cases at an institution provided with general maintenance funds, and with the understanding that buildings and land are to be specifically provided for by the State except as exigencies arise in the progress of the station work. It is the contention of the office that the Federal funds should be expended in the spirit of this interpretation, and its examination is made on this basis, colleges having State appropriations for general maintenance being urged to be as liberal to the station as to other departments of the institution.

The stations all need funds supplementary to those from the Government to provide a larger freedom in their work and to meet many demands from within their States for which the Federal funds are not available. This need is fully realized by the stations, and efforts to secure permanent appropriations are being widely made, which deserve success.

CHANGES IN PERSONNEL.

Fully the usual number of important changes in the station staffs took place during the year. A director was appointed at the Nevada station, the office being separated from that of president of the university, with which it has been combined for some years. This leaves only one station (North Dakota) where the offices of director and president are combined. Seven other stations changed directors during or after the close of the year, namely: California, Connecticut Storrs, Kansas, Kentucky, North Carolina, Pennsylvania, and Rhode Island. In Connecticut the two stations were placed under the directorship of a single officer, and in North Carolina the experimental work conducted by the State department of agriculture was united with that of the college station, the director of the former being placed in charge of the reorganized station.

The directorship of the California station was entered upon by Dr. Thomas F. Hunt, formerly of the Pennsylvania station; Dr. J. H. Kastle succeeded to the directorship of the Kentucky station, vacant by the death of Dr. M. A. Scovell; and Dr. B. L. Hartwell, formerly chemist of the Rhode Island station, was appointed director of the station, vice Dr. H. J. Wheeler, resigned.

At 27 stations there were important changes in the members of the staffs. These changes were for the most part due to the resignation and removal from one institution to another. Such changes, as has been previously pointed out, work a great hardship to the stations and interfere seriously with the continuity of their investigations. With the present inadequate supply of men, however, and the keen competition which exists within and outside of the stations, such changes seem inevitable.

Two men long connected with the station work, Dr. M. A. Scovell, director of the Kentucky station, and Dr. John B. Smith, entomologist of the New Jersey station, died during the year. Brief accounts of their lives and services are given below.

DR. M. A. SCOVELL.

Dr. M. A. Scovell, director of the Kentucky Experiment Station since its establishment in 1885 and head of the agricultural department of the State University, died August 15, 1912, in his fifty-eighth year.

Melville Amasa Scovell was born at Broadway, N. J., February 26, 1855. His collegiate work was done at the University of Illinois, then

the State Industrial University, where he graduated in 1875 with the degree of B. S., specializing in chemistry. He remained with the university for seven years after graduation, being successively instructor in chemistry, assistant professor, and later professor of agricultural chemistry. He received the degree of M. S. from the university in 1877, and of Ph. D. in 1908. While at the university he gave considerable study to the production of sugar from sorghum, and subsequently was engaged in active work in sugar factories in Kansas and Louisiana.

When the Kentucky Experiment Station was organized in 1885, he was elected its director, a position which he held continuously for 27 years. Under his guidance and inspiration the station developed from a very meager beginning to a large and well-equipped institution, with model laboratories and ample facilities for field work, and a revenue of approximately \$125,000, to which the legislature had recently added a permanent annual appropriation of \$50,000.

This constructive effort called for the exercise of large business and administrative ability, and is perhaps to be regarded as Dr. Scovell's greatest work. But in addition he instituted and personally conducted experiments covering a wide range of subjects, including the culture and fertilizing of staple crops, the growing and curing of tobacco, and the handling of dairy cattle; and he planned for and directed the activities of the members of his staff along many important lines of experimental inquiry. As a leader of this group he was inspiring, sympathetic, and helpful, and contributed in large measure to the success of their work.

Dr. Scovell was an expert in dairy cattle, having given much study to the Jersey breed, and was pronounced "the best known and best liked judge of dairy cattle in America." He served as chairman of a committee nominated by the Association of American Agricultural Colleges and Experiment Stations to supervise the tests of dairy breeds at the World's Columbian Exposition in 1893, the most remarkable breed test ever conducted.

In a national way, he was prominently identified with the leading movements for agricultural advancement. For many years he held important offices in the Association of American Agricultural Colleges and Experiment Stations, being president in 1909, and was actively associated with the Association of Official Agricultural Chemists in their work in the development and improvement of methods of analysis. He was for several years a member of the committee on food standards, which worked in cooperation with the Federal Department of Agriculture after the passage of the food and drugs act of 1906.

The foundation which Dr. Scovell laid for experimental work in Kentucky and for the general improvement of agriculture was broad and deep, and will remain a monument to his memory.

DR. JOHN B. SMITH.

John Bernhardt Smith was born on November 21, 1858, in New York City, and was educated in the public schools. He was admitted to the bar in 1880 and practiced law in Brooklyn until 1884. His great interest in entomology and his active work as a member of the Brooklyn Entomological Society led him to abandon his profession in 1884 and accept an appointment as special agent of the Division of Entomology of this department, following which he was for four years connected with the United States National Museum.

Dr. Smith was appointed entomologist of the New Jersey College station in 1889, soon after its organization. During the 22 years of his active work there he built up a reputation for himself and for his station, as a leading authority has said, "second to that of no individual or institution."

He was a great worker, covering a wide range of economic entomology, and a prolific writer, his bibliography including hundreds of titles. His greatest work, and that which perhaps brought him the most fame, was in combating mosquitoes. He studied the life history and habits of the salt-marsh mosquitoes of the Atlantic coast, and found that they breed in the salt marshes and lay their eggs not in the water, but on the mud, and that they fly a distance of 30 to 40 miles. He succeeded in securing a large appropriation from his State and in demonstrating the possibility, at comparatively small expense, of controlling the salt-marsh forms of mosquitoes prevalent in New Jersey.

Dr. Smith's death, which occurred March 12, 1912, was a great loss to his State and to American economic entomology.

SOME RESULTS OF STATION WORK.

The lines of work pursued by the stations increase in number and importance from year to year, and the accumulating results cover more and more thoroughly the field of agriculture of all the States in general and of each State in particular. The progress, scope, and value of this work is indicated in the following illustrations of some of the important findings of the past year:

The Arkansas station reported the discovery of motile organisms within the red-blood cells of cholera-infected hogs of the locality, and the study of these hematozoa to determine their significance and their possible relation to the disease has been undertaken. Other results secured by this station indicate that the virus of hog cholera as it exists in the blood is prominently intracorporeal in habitat, but also occurs in the serum and plasma, and that in the shed blood it escapes from the corpuscles into the surrounding fluid either with or without cytolysis.

Further work by the Colorado station on the marked ammonifying efficiency of what is known as the niter soils of the State has shown that the brown staining effect of these soils may be due to the solution of the bacterial pigment by the soil alkalis, as well as to the growth of the pigment in situ. This station further demonstrated that the presence of an undue amount of nitrates in the soil results in a disproportionate growth of the foliage of the sugar beet and in a reduced percentage of crystallizable sugar and increased percentage of noncrystallizable sugar in the beet.

The Hawaii station found that the pulp accumulating as a result of decorticating sisal leaves contains high percentages of mineral plant food in a readily available form, and clearly demonstrated its value as a fertilizer. In connection with quarantine work this station developed a method of clean culture for bananas by means of which scale infestation can be avoided. The work with seedling varieties of sugar cane at the Hawaiian Sugar Planter's Experiment Station has brought out a number of canes of very favorable yielding capacity.

The Indiana station, in further pursuing its dairy investigations, found that the chemical composition of butter fat is largely controlled by breed, period of lactation, and feed, while the size of the fat globules is controlled largely by breed, period of lactation, changes in feed, and other factors affecting the physical condition of the animal. In studying the factors under the control of the butter maker it was found that the combination of factors through which moisture control in butter is rapidly affected is the regulation of the churning temperature, adjustment of the amount of water present during the working process, and a systematic use of a reliable moisture test.

The Maine station reports that the essential feature of the inheritance in egg production is that the female fowl does not transmit the hereditary factor directly to her daughters, but that she may transmit it to her sons, who may then stamp the quality on their female progeny. By reciprocal crossing of Barred Plymouth Rocks and Cornish Indian fowls, the station produced a new and highly desirable utility type of fowl which carries superior egg-producing qualities and at the same time is distinctly in advance of ordinary breeds of poultry in respect to quality and quantity of meat production. The histology of the oviduct of the hen was worked out, and for the first time a detailed account of its microscopic anatomy was published. The facts set forth are essential to an understanding of the physiology of albumin, membrane, and shell formation in the development of the egg.

The work on hog cholera at the Minnesota station continued to give good results. The production and distribution of the serum during the year amounted to 243,875 cubic centimeters. This sta-

tion has found it feasible to rid badly infested lands of quack grass by a system of rotation of crops in short cycles. The method has been applied by farmers with success to great advantage.

In rotation experiments at the Missouri station, in progress for 22 years, corn after corn yielded 12 bushels, a rotation of corn, oats, and clover 50 bushels, one of corn, oats, wheat, clover, and timothy two years 54 bushels, and the last-mentioned rotation with barn-yard manure 74 bushels of corn per acre at the close of the 22-year period. By selective breeding the station has increased the yielding capacity of one strain of wheat by about 8 bushels per acre. It has further shown that when hogs are worth 6 cents per pound, bluegrass may be utilized for hog forage to return an average net income per acre of \$17.11; clover forage, \$34.11; rape and oats, \$23.64; corn and cowpeas, \$23.71; and rye, \$15.44. The station inoculated 60,000 hogs against cholera during the past year, and of these 85 per cent were saved. It was found difficult or impossible to manufacture the serum in sufficiently large quantities to supply the demand created by an unusually large outbreak of hog cholera.

The plant-breeding work of the Nebraska station has resulted in the development of four superior pure strains of Turkey Red wheat, and it has further shown that pure strains vary not only in their ability to yield and in their resistance to lodging, but also in the shape and quality of the grain.

The New Mexico station has demonstrated that Denia onion seed of good quality can be produced in New Mexico in quantities sufficient to supply the demand, and that onions produced from this home-grown seed show no noticeable difference in color, size, shape, and quality in comparison with onions grown from imported seed. This station also found that, under the conditions prevailing in the locality, peach buds are not materially injured when the temperature falls to 26° F., and that they are most susceptible to frost at the time when the calyx is peeling off.

In North Dakota a flax breeders' association was organized, to cooperate with the seed laboratory of the station, for the purpose of making the plant-breeding work of the station of permanent value by preventing the substitution of nonpedigreed for pedigree seed. With this end in view the seed of improved strains will be sealed with a lead seal and carry with it a certificate of the laboratory showing authenticity of character. The station's work has been largely instrumental in furthering the diversification of agriculture, which is now rapidly developing within the State.

The insect and plant-disease control work of the Ohio station in the southeastern part of the State has given striking results in raising the productive capacity of orchards. In Washington County of the State, where formerly not enough apples were produced for

home consumption, the income from this fruit amounted to \$65,000 in 1910, and to about \$200,000 in each of the years 1911 and 1912.

The South Carolina station has demonstrated that the crawfish lands, or the low, wet lands in the coast region of the State, may be reclaimed, and valuable results along agricultural lines may be obtained by the introduction of efficient tile drainage and the adoption of improved and suitable methods of cultivation.

The investigations of poisonous plants conducted by the Wyoming station have had the effect of reducing in a very striking manner the loss of sheep due to this source. At Medicine Bow, where the field experiments on woody aster were carried on for two years, the estimated annual loss was reduced from \$10,000 to practically nothing. In connection with this work an alkaloid contained in the death camas and named "zygadenine" was separated and crystallized in pure form.

PROGRESS IN FOREIGN COUNTRIES.

There was a good deal of progress during the year in providing new experiment stations and other facilities for agricultural experimentation in foreign countries, the enterprise being extended to countries where such work has not previously been conducted. The nation-wide development of such institutions for agricultural improvement, especially in newly settled countries, shows the well-nigh universal dependence upon such effort among civilized peoples.

The Canadian Government made provision for the establishment of an experiment farm in New Brunswick, and land for the purpose was secured near Fredericton in that Province. The provincial government of Saskatchewan erected near the creamery at Melfort a small poultry-fattening demonstration station, to show in a practical way how poultry may be milk fed on the farm. At Scott a station was put in operation for the purpose of studying the agricultural problems of the northwestern Saskatchewan. An experiment station to study fruit culture under irrigation was located at Invermere, British Columbia, with 52 acres of land at its disposal. Provisions were also made to locate an experiment station on an area of 135 acres at Sydney, British Columbia, on Vancouver Island.

In Mexico arrangements were made for the location of model farms in the State of Michoacan, a demonstration farm at Colima, an experiment station for fruit culture in Chiapas, a general experiment station in the Tenango Valley, and a tobacco experiment station at San Juan Bautiste with grounds containing about 100 acres.

The Peruvian Government established at Santa Beatriz a central experiment station under the title Estacion General Agronomica del Peru, in which existing lines of work are to be combined with other lines to be inaugurated. This central institution, which is to control

the theoretical and experimental work in agriculture, will include sections on general agriculture, applied botany and vegetable physiology, microbiology, serums and vaccines, physics and agricultural chemistry, zoology, entomology, viticulture and wine making, forestry, rural engineering, and extension.

Considerable activity was shown during the year in the establishment of experiment stations for various purposes in Brazil. A station for cotton culture was established at Caxias, Maranhao, a veterinary station at Bello Horizonte, a demonstration farm at Municipio de Lavras, and a zootechnical institution at Uberaba, Minas Geraes, a tobacco experiment station at Parahiba, an experimental wheat-growing area in Rio Grande do Sul, a sugar-cane station at Pernambuco, and one at Campos in the State of Rio de Janeiro.

An irrigation experiment station was organized at Buenos Aires and placed under the supervision of the faculty of agriculture and veterinary science at the University of Buenos Aires.

The Board of Agriculture of England has announced that the institute of dairy research is to be attached to University College, Reading. This is one of the six research institutions provided for in the plan for agricultural development which was entered upon under Government auspices a few years ago. Subject to compliances of the college in the conditions imposed by the board of agriculture, an amount up to a maximum of £2,500 is available annually from the development grant to provide two-thirds of the annual maintenance cost of the dairy research institute, and the board in addition provides for one-half the cost of the necessary buildings.

During the year a permanent commission for the study of crop production and the supervision of experimental gardens in the colonies was established in the French colonial ministry. On May 30, 1912, the University of Poitiers, France, opened a station of vegetable biology on a neighboring piece of ground of about 74 acres constituting a Government grant for the purpose. The buildings include a large laboratory with necessary equipment for studies in plant biology.

In Austria provisions for the establishment of an institute for plant breeding at Eisgrub, Moravia, were made by the regent of Liechtenstein. The buildings which are in course of construction will include laboratory facilities and lodgings for investigators and post-graduate students. E. von Tschermak, professor of plant breeding at the agricultural high school at Vienna, has been given the directorship of the institute.

An experiment station for the study of general agricultural problems was established in Spain at Alcala de Henares, and a station for olive culture at Lucena, while for the purposes of demonstrating practices in dry farming and crop rotation, King Alphonso set aside 1,200 acres of the Royal Domains of Pardo near Madrid.

The extension of experiment station work in Asia included, among other forms of development, the location in India of a demonstration farm at Sambalpur, Bengal, a tea experiment station at Toklai, Assam, and an experiment station for work with paddy and sugar cane at Manganallur, Tanjore district of the Madras Presidency. At Colombo, Ceylon, a quarantine station was established for the disinfection of seeds and plants to prevent the introduction of injurious insects.

Japan established near Nakano, Tokyo, a sericultural station with three outlying branch stations.

In the Philippine Islands a tobacco station was established at Iligan; a sugar-testing laboratory was provided in the Bureau of Science, Manila, for the purpose of fixing and estimating standard samples of different classes of sugar as they are marketed at Manila; and stock-breeding work, mainly horse breeding, was inaugurated at Bagamanoc, Catanduanes Island.

In the German African colonies the system of experiment stations was extended by the establishment in German East Africa of a station at Kibongoto in the Moschi district, for the study of stock raising and crop production, more particularly tobacco, cotton, coffee, and leguminous and other crops; a station at Myombo, Mrogoro district, and one at Tabora in the Tabora district, both for cotton culture. In German Southwest Africa an experimental farm was located at Neudamm, near Windhuk, for testing cereal and forage crops under dry-farming conditions. At Okahandja a special tobacco experiment station was installed. For animal husbandry a station was established at Jaunde, Kamerun, and for work with cotton a station at Kamaa in the Kokode district of Togoland.

The recent agricultural development of the Belgian Congo region included, among other lines of progress, the establishment of experiment stations at Elisabethville, where 400 acres were prepared for experimental work at Kinsengwa on a farm of about 500 acres, and at Stableyville where the station grounds contain about 100 acres and the problems of coffee culture are to be especially studied.

Other African experiment stations were established at Zomba in Nyasaland where about 170 acres are to be devoted to work with cotton; one near Lochard, Rhodesia, for the study of the farming problems of the granite areas in Matabeleland; and in Sudan at Tayiba, near Wad Medani, where 300 acres are provided for cultural experiments with other crops.

INSPECTION OF THE STATIONS.

In accordance with the usual practice of the office, a personal inspection was made during the year of the work and expenditures of each of the experiment stations receiving Federal funds. This inspection

served as the means of securing a large amount of first-hand information in regard to the progress of the stations and their relations to the colleges with which they are connected and to the agriculture of the States, and the opportunity was embraced for conferences with the station officers in regard to station organization and administration. This inspection was participated in by four members of the office force, the director (A. C. True), assistant director (E. W. Allen), W. H. Beal, and Walter H. Evans.

The following reports upon the several stations are based on the results of this inspection, together with the annual financial statements of the stations, rendered on schedules prescribed by the Secretary of Agriculture, and the printed and other reports received from the station officers.

ALABAMA.

Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn.

Department of the Alabama Polytechnic Institute.

J. F. DUGGAR, M. S., *Director.*

The Alabama station was active during the past year in organizing work under the continued State appropriation of \$27,000 annually for local experiments and special investigations. The large number of assistants added to the staff for this purpose enabled several departments of the station to conduct experiments on farms throughout the State. F. A. Wolf, added to the staff as plant pathologist, took up the study of diseases of leguminous crops and of cotton among other lines of work. Otherwise, the experimental work of the station was chiefly a continuation of the activities in progress during the preceding fiscal year.

All Adams fund projects were pursued actively, and to some extent the results secured were summarized for publication. The department of agronomy gave special attention to the breeding of cotton, oats, and corn, the studies relating in part to the establishment of correlations in these plants. Analytical data in the study of soil requirements as indicated by plant composition were further accumulated in experiments with cotton. Among other facts, it appeared that by fertilization with potash this element is materially increased with more or less uniformity. The study of the relation between the increased content of plant food elements in the plant and fruiting capacity or crop production was entered upon during the year. For the purpose of these studies soil was secured from different parts of the State and placed in earthen pots for the experimental work.

The physiological chemist continued the study of the properties of lards as affected by feeds with a view to applying the scientific results in the solution of practical problems such as the effect of feeds upon

the keeping qualities of lards and other similar factors entering into the value of the product.

The study of the rice weevil was continued throughout the year with steady advance. The life history of the insect was quite thoroughly determined, and data of a fundamental nature were gathered in regard to fumigation for its control. An article recording some of the facts with reference to fumigation has been published.¹ The work during the past year involved the design and improvement of apparatus for its successful procedure.

The investigation on the ripening of persimmons reached a stage indicating that the loss of astringency is due to adsorption of the tannin by an associated colloid, a hydrogel, upon its coagulation. The results further pointed to the possibility of processing the Japanese persimmon by means of carbon dioxid under pressure and thus rendering it nonastringent in advance of the final processes of ripening. The study was extended to the acorn, particularly the fruit of the water oak (*Quercus laurifolia*), and conditions were found analogous to those in the persimmon tannin cells.

Satisfactory progress was also made in the investigation of transpiration in the cotton plant, which involved a study of physiological methods for the investigation of transpiration and associated phenomena, including stomatal behavior, rates of diffusion of water vapor relative to the size of the stomatal pore, and boll shedding. Special methods and apparatus were devised for observations on the growing plant in the field. The portion of the project relating to boll shedding was carried on under cooperation with this department. These studies were pursued at the station and at the Desert Botanical Laboratory of the Carnegie Institution near Tucson, Ariz. The results indicated that boll shedding varies with the evaporating power of the air.

The work on rot-resistant peaches was continued by the horticulturist and several seedlings from crosses made in 1911 were secured. During the year work was begun on a new project to determine the factors essential to the successful germination of potatoes in producing a fall crop. For the purpose of this work a storage room with a self-recording temperature and humidity apparatus was provided.

The activities under the Hatch fund included in agronomy experiments with cotton on the relative fertilizing values of ground phosphate rock and acid phosphate, the effects of planting heavy and light seed, and the best time for applying nitrate of soda. Variety and culture experiments were conducted with cotton, corn, wheat, oats, crimson clover, and soy beans. Studies of varieties of cowpeas and sorghum, the relative amounts of food produced by various crops suitable for hogs, and of numerous forage plants, including

¹ Jour. Econ. Ent., 4 (1911), No. 2, p. 230.

alfalfa, vetches, clovers, kudzu, and grasses, together with experiments in the manufacture on the farm of draintile from cement and sand and in the rotation of crops were also in progress. Local tile drainage experiments were begun in cooperation with this office.

The entomologist gave considerable attention during the year to the cotton-boll weevil and inaugurated an active campaign against this pest. The cotton worm appeared in large numbers and was made the subject of study. Application of powdered arsenate of lead was found to be an effective treatment. Observations were further made on the relative injury of close-husk and loose-husk corn by the boll-worm, and an active campaign was also inaugurated against the house fly and mosquitoes.

In horticulture, experiments with a variety of fruits, vegetables, and flowers were in progress and new orchard plantings of apples and peaches were made. Nursery inspection was carried on as heretofore.

The veterinarian studied the therapeutic action of China berries on horses, mules, pigs, and poultry, the poisonous effect of the cocklebur on pigs, and the effect of peanuts as the sole feed for pigs.

The animal husbandman tested the value of tankage as a supplement to green pasture for swine and gave attention to methods of producing pork on the farm and home curing of meat. The results of calf-feeding experiments in cooperation with this department, and of cooperative steer-feeding experiments were summarized and published. The cost of raising beef cattle under average southern conditions, the use of cottonseed by-products on dry pasture for summer and fall market, winter fattening of calves with dry feed and silage, and fattening steers with hay in addition to cottonseed meal and hulls were also studied in cooperation with this department. The dairy herd has been bred up to a condition fitting it for experimental work.

In the chemical department the work on breeding cotton for oil and protein content was continued and the analytical work for the fertilizer and feeding-stuffs inspection was carried on as usual, together with miscellaneous work for other departments of the station.

Much of the local work inaugurated under the new State funds is experimental in character and of demonstration grade, but in some cases advantage is taken of it to make it an aid to research. The animal husbandman was able to inaugurate experimental work in animal industry and poultry industry in eight localities, the departments of horticulture and entomology to operate in about half the counties of the State, the extension department to extend its activities into all parts of Alabama, and the agricultural department to conduct fertilizer experiments, variety tests, and other special investigations in every county of the State. A beginning was also made under these funds in testing machines in the sowing of oats by the

open-furrow method and in testing out, in the numerous localities, varieties or strains selected or bred at the station in previous years. The profits of poultry raising and the value of pasture for laying hens were studied at Pinson with a State fund of \$1,000.

The publications received from this station during the year were as follows: Bulletins 156, Peach Growing in Alabama; 157, The Satsuma Orange; 158, Fattening Beef Calves in Alabama; 159, Heading Off Boll-weevil Panic; 160, Local Fertilizer Experiments with Cotton in South Alabama in 1911; 161, Lime for Alabama Soils; 162, Local Fertilizer Experiments with Cotton in North Alabama in 1911; Circulars 9, The Relation of the County Superintendent of Education to the Boys' Corn Club Work; 10, Fighting the Cotton Worm; 11, The Relation of the Teacher to the Boys' Corn Club Movement—How to Organize a Club; 12, How to Organize and Conduct a Girls' Canning Club; 13, School Gardening; 14, pt. 1, Vegetable Growing in Alabama; 15, The Southern Pine Beetle and Its Control; and the Annual Reports for 1909, 1910, and 1911.

The income of the station for the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation	34,982.85
Farm products.....	834.72
Miscellaneous	3,622.28
 Total.....	 69,439.85

The Alabama station, as a result of the generous State aid, has entered upon the most important era of expansion in its history, and the wisdom of this policy will be reflected without doubt in the progress of agriculture within the State.

Tuskegee Agricultural Experiment Station, Tuskegee Institute.

Department of the Tuskegee Normal and Industrial Institute.

G. W. CARVER, M. Agr., *Director.*

The work of the Tuskegee station during the year included cotton breeding, corn breeding, and experiments in the growing of alfalfa. Some new varieties of cotton distributed in the vicinity of the station and in different sections of the State have given gratifying results. Two acres of alfalfa sown in October, 1911, made a good growth and yielded this year at the rate of 3 tons of hay per acre in four cuttings.

Experiments in the production of forage were carried on with Kafir corn, teosinte, pop corn, and soy beans. Considerable work was also done in composting muck leaves and barnyard manure for the purpose of determining to what extent this compost could be used in place of commercial fertilizers. A little over a bale of cotton per acre was produced with the application of this compost alone.

The station further gave attention to testing and comparing methods of pickling and curing meat in hot weather and in certain instances devised and adopted formulas to suit conditions. Similar attention was given to the canning and preserving of fruits and vegetables.

The officers of the station continued to pursue agricultural extension work among the rural negro population in the vicinity of the station and in other parts of the State.

The following publications were received from this station during the year: Bulletins 20, Cotton Growing for Rural Schools, and 21, White and Color Washing with Native Clays from Macon County, Ala.

The station is maintained by an annual State appropriation of \$1,500. With these limited means the station is exerting a commendable influence on the agricultural practices and the thrift of the people which it serves.

ALASKA.

Alaska Agricultural Experiment Stations, Sitka, Kodiak, Rampart, and Fairbanks.

Under the supervision of A. C. True, Director, Office of Experiment Stations, United States Department of Agriculture.

C. C. GEORGESON, M. S., *Special Agent in Charge, Sitka.*

Few changes occurred in the personnel of the Alaska stations during the year, and the work was carried on uninterruptedly according to previously outlined plans. Minor improvements in equipment were made, and at Kodiak a tract of land occupied by the station on Kalsin Bay was definitely set aside for its use by Executive order dated April 1, 1912. The clearing of land was continued for the extension of the station's work.

At the Sitka station the horticultural work along other lines made favorable progress. The hybridization of strawberries and raspberries was continued, and a considerable number of hybrid strawberries of large size and excellent quality were grown for the purpose of testing them on an extensive scale. Of more than 100 plants bearing large berries, 15 were selected for propagation and special care. About 4,000 young plants, grown for selection, have not yet fruited. Plants of the strawberry indigenous to the interior were brought to the station for plant-breeding purposes. Additional experiments were carried on in hybridizing the raspberry and the salmonberry, and some of the plants produced fruit during the year.

Of the tree fruits, the cherries and apples flowered abundantly and set a fair crop. The varieties of apples reported as producing fruit in the fall of 1911 were Yellow Transparent, Raspberry, Sylvan Sweet, Whitney, Hyslop, and *Pyrus baccata*, all of which have crab

blood. The apples produced were small to medium in size as compared with the normal size of each variety, and had matured fully under favorable weather conditions by the middle of October. Nearly all the varieties represented in the small test orchard and the nursery made a normal growth the past season, and the wood matured better than usual. Successful work was also done with gooseberries, currants, and raspberries.

The vegetable work was limited to making comparative tests of different varieties to determine those best suited to the climatic conditions. A long list of varieties of potatoes was tested on comparatively small plats. Gold Coin, grown in a single row 1,170 feet long, the largest plat in the test, yielded at the rate of 456 bushels per acre. A number of hardy perennials were tested to determine the kinds that may be recommended for general culture.

At the Rampart station work was continued in the crossbreeding of barley, and selections were made of the earliest maturing and best individual plants from each of a number of the best varieties. A beardless hybrid under test matured in 80 days and showed other qualities of value under Alaska conditions. The improvement of oats was attempted by selection only. Finnish Black ranked first in productiveness, while Great Mogul, Banner, and Swedish Select also gave promising yields. In tests of winter grain the more resistant varieties of winter rye, although much hardier than winter wheat, winterkilled from 25 to 50 per cent. Kharkov, the hardiest variety of winter wheat tried, winterkilled badly.

In a series of fertilizer tests with oats and potatoes the use of sodium nitrate at the rate of 500 pounds per acre gave the best results, indicating, as all fertilizer experiments thus far conducted have done, that nitrogen is the element deficient in the soil. Variety tests with potatoes showed that a number of varieties produced tubers of good quality and appeared adapted to the conditions of interior Alaska.

Among the grasses tested awnless brome grass, red fescue, and Kentucky bluegrass gave favorable results, and a number of leguminous plants, including *Vicia cracca*, mountain alfalfa, Grimm alfalfa, sand lucern, and alsike clover survived the second winter and made a fair growth. *V. cracca* and alsike clover were the only ones that produced seed. Turkestan alfalfa made a good growth and was mowed the first week in September.

At the Fairbanks station 27 varieties of potatoes were grown in 100-foot rows and all made good yields. Three acres of Eureka, Early Ohio, and Gold Coin averaged 6 tons per acre over the field on second-year unfertilized ground. Five acres of timothy drilled thickly on June 23 made a growth of from 6 to 10 inches during the season. A few leading varieties of wheat, oats, and barley seeded

on May 30 made such a rank growth that they lodged before the heads were completely formed. This retarded the ripening but all matured good seed. A half acre of North Finnish oats seeded on May 16 was headed by July 4, and thoroughly ripe and harvested August 11, the earliest to ripen of any known spring seeding of the locality (Pl. I, fig. 1). An acre of Banner oats seeded June 1 on high land sloping slightly to the north matured and was harvested for seed. Kharkov winter wheat and two fall ryes seeded August 5 were partly winterkilled, but matured perfectly by August 10 the next year. Oats was again grown successfully for hay.

Work at the Kodiak station was more satisfactorily carried on during the year than in previous years, due to better and more extensive equipment and to more efficient help. About 60 acres of new meadow land was added to that cut over the year before, making a total of 215 acres of land which can be cut over with the mowing machine. About 2 acres of beach land broken up the fall before was seeded to oats and barley for hay after disking in a heavy dressing of manure. The crop was cut October 1 without being damaged by frost and yielded about 1 ton per acre. On clay-loam soil, seeded to oats for two years past, a crop of oats yielded about 2 tons of hay per acre.

The station put up over 100 tons of hay from native grasses and procured a large quantity of silage from the same source. The hay and silage were made principally from beach grass, but about 25 tons of native blue top was put up for silage to test its properties.

The live-stock work of this station with cattle and sheep proved very successful. Both the herd of Galloways and the flock of sheep increased satisfactorily and the native grasses on which they were pastured proved nutritious and sufficient, the hay and silage made from them maintaining both cattle and sheep during the winter whenever it was necessary to feed. The live-stock work, however, received a severe setback due to the eruption on June 6, 1912, of a volcano about 95 miles from the station. This eruption covered the pastures, even at this distance, to an average depth of 14 inches with ashes, rendering it necessary to provide forage for the animals. The heavy fall of ashes was fatal to some of the sheep, but none of the cattle died as the immediate result of the eruption. An attempt was made to determine whether tame grasses, clovers, and cereals will grow in this deposit of volcanic ash.

The only publication issued during 1912 was the Annual Report. The income of the station during the past fiscal year was as follows:

United States appropriation	\$30,000.00
Sales and other funds	6,160.33
Total	36,160.33

The Alaska stations during the past year contributed a large amount of definite information on the agricultural and horticultural possibilities of Alaska in different sections, and on the methods and varieties of crops to be employed for success. The stations' work in growing cereal crops, hay and silage production, vegetable growing, and in animal husbandry is being followed and certain localities are already largely supplied with home-grown vegetables, particularly potatoes and other farm products.

ARIZONA.

Agricultural Experiment Station of the University of Arizona, Tucson.

Department of the University of Arizona.

R. H. FORBES, M. S., *Director.*

The first State Legislature of Arizona greatly increased the State aid by appropriating \$18,000 for dry farming, date culture, horticulture, farmers' institutes, publications, and miscellaneous expenditures. The lines of work mentioned include intensive farming at Yuma, and dry farming near Snowflake, Prescott, and in the Sulphur Springs Valley. No new buildings were constructed during the year, and the number on the station staff remained unchanged.

The investigations on the approved Adams fund projects were continued, although the main features of several of these studies have been concluded. Further work was done on some of the projects for the purpose of confirming results. The study of the toxic effect of copper compounds on crops was continued and the accumulated data were prepared for publication. The injurious character of copper-mine washings was demonstrated, and laws passed by the legislature were based upon the data secured in this connection.

The further work on date ripening was confined largely to the determination of methods for ripening different varieties, as it was found that varieties differed in the treatment required. Heating the dates for three hours and bringing the temperature up to 65° C. had the effect of destroying or driving out all insects and of greatly improving the quality of the fruit of some varieties, especially that of Rhars. This work has shown that bunches of dates cut and brought in before the usual autumn rains set in can be artificially ripened with only 10 to 15 per cent failing to make a good merchantable product. These experiments also brought out the fact that the Rhars dates artificially ripened in an atmosphere of carbon dioxid were much superior to those ripened naturally. For some of the varieties the methods were applied commercially, and the fresh dates were successfully shipped to a number of distant points.

A study of the olive under different Arizona conditions included examinations of an extensive series of oils and a consideration of the

methods of manufacturing olive oils. The effect of extreme conditions, such as high temperature and drought, was also studied.

The investigation of the underflow in the Sulphur Springs Valley was continued, a study being made of the ground-water supply and its relation to the surface run-off. Work to determine the relationship between the water in the streams and the water supply in the wells of the area was also in progress. Special consideration was given to the question of developing the ground water adapted to agricultural use.

In plant breeding the work with alfalfa was carried forward with the differentiated strains on increase plats of one-fourth to one-half acre in size. Promising plants were also secured in other parts of the State, and in all 225 were carried in row tests. A preliminary report setting forth some of the more salient features of this work is to be published soon. On the study of the native beans of the Southwest, the station issued Bulletin 68, giving the results of the investigation particularly with reference to the kind locally known as teparies. These beans are native to the region, germinate quickly, endure severe drought, produce seed in the hottest and driest weather, and mature in less time than ordinary beans, thus being capable of producing two crops annually on the same ground. Forty-seven types of teparies, showing a wide range of character and suggesting the possibility of developing many horticultural specialties from this foundation stock, were isolated.

Supported by Hatch and other funds, a large amount of work was in progress in different parts of the State. The work at Yuma in intensive agriculture was continued along the lines previously described, but through the appearance of nematodes in the soil it became necessary to restrict the crops to those growing in winter or to grains grown in the summer. A considerable amount of data regarding the experiments at this place has accumulated and is being worked up for publication.

The animal husbandry work at Phoenix, which has been conducted largely with sheep, made special progress, and a publication including the results of the study of the third generation is about to appear. In this breeding work, the essential characteristics of ideal types of sheep for both the ranges and the irrigated valleys have been taken into account. A practical test of Tunis-native rams on the ranges showed them to be alert and active and begetting a much higher percentage of lambs than Oxford-native rams which were used for the same flocks. The results of these crossbreeding experiments show that the herding qualities of the native types have not been lowered, the breeding qualities and constitution have been improved, the production of lambs at any season assured, the quality of wool increased, and the improvement in mutton effected.

The plant breeder carried on some breeding experiments with dates for the purpose of securing a variety that will ripen normally and at the same time have the desirable qualities of some of the superior types. The variety chosen as the best for the work was Deglet-Noor, which furnishes a fruit of higher quality than any other variety so far producing in Arizona. The principal object in view is the development of an earlier ripening form, the only character lacking in Deglet-Noor to make it a nearly ideal date for Arizona conditions being its late maturity. The date-ripening work has shown that this variety may be grown at a profit in Arizona when artificial methods of ripening are employed. During the year about 500 first-generation seedlings were secured. The plant breeder also reports having found among the Papago Indians a variety of sweet corn that seems very promising.

The dry-farming work in the Sulphur Springs Valley during the past season indicated that summer fallowing resulted in the loss of nearly all moisture in the soil due to the great diurnal range of temperature and the great heating of the soil mulch. Winter irrigation followed by disking and harrowing held sufficient moisture in light soils and matured crops until in June. With furrow irrigation practiced in January, $3\frac{1}{2}$ to 4 inches of water was found sufficient to mature good crops, while small summer irrigations, amounting to $1\frac{1}{2}$ to 2 inches, were sufficient to secure good yields of milo maize, sorghum, teparies, and beans.

The dry-farming work at Prescott, where 55 acres are under cultivation, included tests of varieties, methods of cultivation, supplemental irrigation, fallowing, and continuous cropping, and observations on the effect of thickness of soil mulch, penetration of rain, methods of preparing land, and other phases of crop production. During 1912, corn, beans, milo maize, potatoes, alfalfa, and barley matured, but cotton did not. Observations were in progress on the depth of plowing, time and method of planting different crops, subsoiling, disking, and other cultural practices. In connection with this work, an attempt was made to grow apple, plum, peach, and pear trees without irrigation. The work at Snowflake was carried on along similar lines, but on a smaller scale. The work at McNeal was closed out.

At Phoenix tests were made of sweet and sour stocks in the citrus orchards set out for experimental purposes among the high date palms for protection. The old date palms were used to some extent in methods of controlling date insects, and some experiments with grapes were undertaken. Observations on the ornamental and shade plants of the Southwest, together with studies of the arborescent flora of the region, were continued and manuscript covering part of this work was prepared.

The station carried on cooperative work with this department in studies of range improvement, date culture, and irrigation.

The publications received from this station during the year were as follows: Bulletins 63, Irrigation and Agricultural Practice in Arizona, and 66, Chemistry and Ripening of the Date—Ripening Dates by Incubation.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	8,700.00
Individuals.....	7,168.06
Farm products.....	2,625.99
United States Geological Survey.....	350.00
Total.....	48,844.05

The Arizona station is making very satisfactory progress. It is pursuing work along the lines of agricultural development of the State, and the results secured help to supply the demand for practical and scientific information relating to the different agricultural industries.

ARKANSAS.

Arkansas Agricultural Experiment Station, Fayetteville.

Department of the University of Arkansas.

C. F. ADAMS, B. Agr., A. M., M. D., *Director.*

At the Arkansas station the year was again marked by a number of changes on the station staff and the consequent passing on of lines of work from one investigator to another. A poultry department for experimental work in that branch of animal industry was established, and among minor improvements were a hog house and barn for animal-husbandry work.

The results of some of the Adams fund work of the station were published during the year. On the hog-cholera project studies were made of the distribution of the virus in the blood and of the associated bacilli. It was found that the virus is also carried by the blood corpuscles, as these are fully virulent when rendered serum-free by centrifugal washing. Serum rendered cell-free by centrifugation and filtration was also found virulent, although in less degree than the blood corpuscles. These results led to the presumption that the virus of hog cholera is intracorporeal in habitat and protozoan in nature. In the work on the associated bacilli an effort was made to determine their possible relation and their etiological significance. Slightly varying strains were isolated for a more complete comparative study of their biological characters. A motile intracellular organism in the red blood corpuscles was discovered and its presence was observed in all the cholera-infected hogs studied. Investigations were also made of the heat resistance of virus. Further work on the Texas-fever project was restricted

to histological studies of the ova and young ticks in the determination of the life history of the parasite. Microscopic studies of anatomic features of the tick were made.

Work on the woolly aphid consisted mainly of attempts to get immune stock, and on the apple-tree borer of life-history studies.

The study of losses in soil fertility in fruit growing was conducted actively and the data secured for different fruits was compiled and tabulated. The chemical work on the project progressed satisfactorily, and in the experimental orchard devoted to the work some of the trees began to fruit, which made other phases of the investigation possible.

The project on the nature and cause of injury by apple-twig blight was closed out at the end of the year. The chemical study on the relation of susceptibility to starch content was completed, a quite constant relation being found to exist.

The study of a new disease of the apple attacking young trees and causing the death of old ones in infected orchards, and reported from practically every apple-growing region of the State, was undertaken during the year to determine the cause, special attention being given to the possible discovery of a causative organism or to demonstrating the disorder to be a physiological effect.

In the cotton-breeding project the first-generation hybrids were secured during the year and studies for the purpose of determining the Mendelian qualities were begun. About 35 acres were set aside for this work, and a new gin and a machine for testing the fiber were provided.

In the cottonseed-meal project a test was made of various methods of treatment of cottonseed meal in removing or reducing its toxic action. The poisonous character of different extracts secured by simple methods of extraction with aqueous or acid solvents or by cooking was also demonstrated. The results obtained in this work are briefly set forth in Bulletin 108 of the station.

Under the Hatch fund, the entomologist conducted economic studies on the peach borer, apple-tree borer, and the lesser apple-tree borer. Different methods of protection including wrapping with paper, the use of veneer protectors, and of asphaltum were given trial. A bulletin was published during the year which was based in part upon original work on round-headed apple-tree borers, the apple-tree moth borer, and the terminal worm. Observations on the San José scale were made in the orchards of the State and brief notes on this work, together with practical suggestions were included in a bulletin describing this insect and the methods of its control.

The chemist cooperated in a butter storage experiment by making complete analyses of samples for the purpose of determining the changes occurring in storage and also took part in the study on the

loss of soil fertility in fruit growing mentioned above. Chemical tests were also made of oils used for orchard heating.

The plant pathologist carried on spraying experiments to ascertain the amount of injury caused by using certain spray mixtures at certain seasons on apples and peaches and also made a test of the effect of size and shape of spray nozzles on the character of spray produced. Brief notes on observations made on root rot and blight of the apple were published and a bulletin on a preliminary study of rice blight was issued during the year.

The horticultural work consisted of fertilizer and culture experiments with potatoes, strawberries, and other crops, studies on the effect of cultivation, tests of methods for the prevention of pear blight, and other lines of effort continued from the previous year. Experiments in orchard heating were taken up and equipment for this work was secured.

The agronomist had in progress a number of experiments and tests with most of the staple crops including cotton, corn, small grains, grasses, and other forage plants, particularly alfalfa. Studies were made of varieties, soil preparation, and other cultural methods, rates and dates of seeding, and other similar subjects. Attention was further given to soil treatment, involving crop rotation, growing leguminous plants, turning under green crops, use of barnyard manure, prevention of erosion, and other means and methods of soil improvement.

In animal husbandry, a feeding experiment was conducted on the value of rice and rice by-products fed to hogs.

The publications received from this station during the year were as follows: Bulletins 107, The San José Scale and How to Control It; 108, Cottonseed Poisoning of Live Stock; 109, Diseases of Apple Trees and Fruit Caused by Fungi and Insects; 110, Rice Blight; Circulars 10, Brood Sows—Selection, Feeding, and Management; 11, Purchasing a Fertilizer; 13, Suggestions on the Storage of Apples; and 14, Growing Alfalfa.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$14,988.00
United States appropriation, Adams Act.....	15,000.00
Balance from United States appropriation, Hatch fund.....	12.00
State appropriation, including balance from previous year..	41,110.91
Individuals.....	525.00
Farm products.....	1,176.78
Miscellaneous.....	24,029.00
Total.....	96,841.69

The Arkansas station has made encouraging progress in spite of quite adverse conditions due to loss of men and shortage of funds. It is enjoying increased popularity in the State, and deserves more liberal support.

CALIFORNIA.

Agricultural Experiment Station of the University of California, *Berkeley*.

E. J. WICKSON, D. Agr., D. Sc., *Director*.

The work of the California station during the past year retained its extensive and varied character and was conducted in various parts of the State. A few minor changes occurred on the station staff, and since the close of the year E. J. Wickson who retired from the directorship was succeeded by T. F. Hunt, former director of the Pennsylvania station. A new laboratory building was nearly completed at the Citrus substation at Riverside (Pl. I, fig. 2), and additional laboratory room was provided and occupied at Whittier.

The work on the Adams fund investigations of the station was continued quite actively on some projects, while on others the prosecution of research was conducted with less vigor. The study of the relation of marly soils and of lime to chlorosis of citrus fruits was practically closed out, the results indicating that the presence of marl favors the development of chlorosis largely by causing water to stand about the trees, which results in insufficient aeration of the soil. The principal work done on this project was in the nature of pathological investigations on some of the causes of chlorosis and its control.

The studies on the toxicity of the various arsenical poisons used to destroy insects were restricted mainly to a detailed study of the physiological and chemical effects of these insecticides. As a result of the study of hydrocyanic acid and its effect on insects, dosage tables were published as Bulletin 220, which show the quantity of each ingredient required under the given dimensions of the fumigating tent and its rate of leakage. Considerable time was also devoted the past year to a further study of the effect of hydrocyanic-acid gas on the eggs of San José scale and other scale insects, and the strength and quantity of the gas required to destroy these eggs was worked out in a number of cases.

In the study of the influence of environment on the gluten content of grains, the work had a special bearing on the effect of sunshine on the gluten content of wheat and the effect of long and short growing seasons on the composition of the grain.

As a result of the work on the tolerance of plants for alkali in soils, Bulletin 225 on the tolerance of eucalyptus for alkali was published. The tolerance was determined for a number of species, and the relation of such factors as cultivation and irrigation to the limit of tolerance was studied. It was found that carbonate of soda was the most hurtful ingredient of alkali, while the sulphates and chlorids, even in large quantities, caused but little injury.

The study of soil bacteria under arid conditions was continued in the laboratory and greenhouse and in addition to other studies on



FIG. 1.—POTATOES AND OATS AT FAIRBANKS, ALASKA.



FIG. 2.—CITRUS EXPERIMENT STATION LABORATORY, RIVERSIDE, CAL.



FIG. 1.—DAIRY BUILDING, DELAWARE STATION.

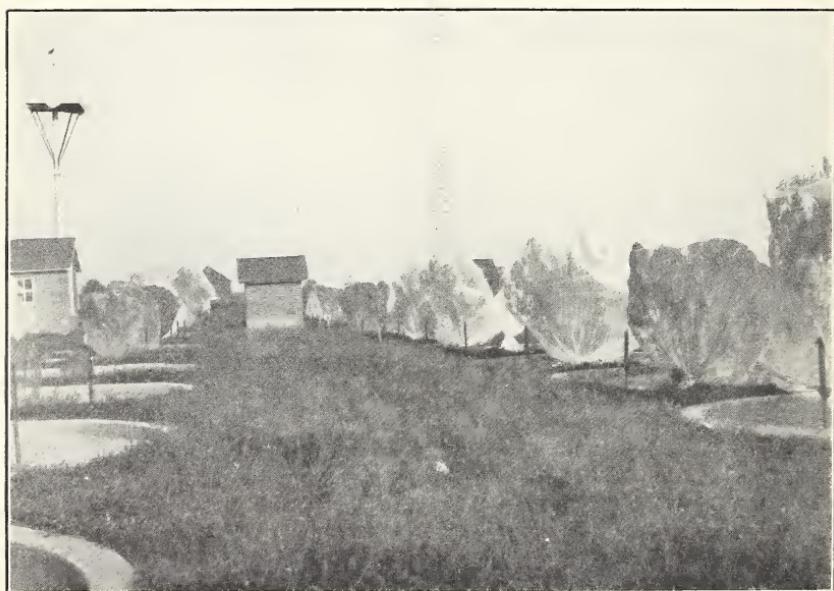


FIG. 2.—FERTILIZER EXPERIMENTS WITH PEACHES GROWN IN CEMENT PITS, DELAWARE STATION.

the physics, chemistry, and bacteriology of the project a bulletin on some of the results secured in the greenhouse work was prepared.

The investigations on the nature of certain physiological plant diseases was largely carried on at Whittier and studies of the rôle of soil moisture in relation to certain diseases, the metabolism of the rind of the orange and lemon as a means for determining the cause of splitting, and of the mottled leaf of citrus trees were included.

A further study of the causes of sterility of almond trees confirmed previous conclusions. An effort was made to secure crosses between fine but sterile varieties and those being good pollen bearers, and weather conditions and the character of late blossoming were studied in connection with the problem of overcoming sterility in the more valuable sorts.

A detailed study of red and yellow scales of citrus trees was continued in southern California as work on the life histories of these insects, including the determination of possible morphological and physiological differences. A bulletin each on the red or orange scale, the black scale, and the purple scale was issued during the year.

Nicotiana hybrids were studied in plat and field work, and several hundred plants representing the third hybrid generation were under investigation. A number of quadruple crosses were also under observation and extensive notes were taken on the splitting and combination of characters in all the plants studied. Several papers have already been published on this work.

A large amount of work was carried on with Hatch, State, and other funds and definite progress was reported in a number of lines. The viticultural work supported almost entirely by State funds and embracing both viticulture and enology included experiments on the resistance of various kinds of stock, variety tests, and observations on the adaptability of certain stocks to *vinifera* varieties. Other lines of work pursued were bud selection and studies of grape diseases at Davis, tests of varieties and of methods of curing and handling raisin grapes at Fresno, the cultivation of table grapes in the Imperial Valley, and the study of problems in wine making at Berkeley.

The horticultural work at Davis and elsewhere embraced experiments on the adaptability of varieties of walnuts, the comparative cultural and commercial value of hard-shelled and thin-shelled varieties and the value of different varieties of almonds, cherries, prunes, plums, peaches, and other fruits for the Sacramento Valley. Breeding experiments were made with potatoes and tomatoes to determine the application of Mendelian law to these plants.

The department of agronomy conducted further work on the possibility of rice growing in the Sacramento Valley and carried on variety and culture tests with alfalfa in different parts of the State.

Some experiments with barley and wheat and with various leguminous plants as cover crops were reported upon, and other work to be taken up at the station to be established in the Imperial Valley was planned. Breeding work with Lima beans was described in part in Bulletin 224 of the station. Tests of corn, sorghum, milo maize, and other crops to determine their adaptability to different parts of California were conducted and particular attention was given to the study of cover crops for different portions of the State.

The entomological department made observations on the efficiency of spray nozzles, devising for this purpose a form of apparatus for studying the mechanics of the spray and determining its spreading and penetrating power. Some work was also in progress on the control of the Argentine ant and mosquitoes. The possibility of utilizing cold storage for the shipment of insects was tested to a limited extent. This department was also in charge of the insect control work conducted under State auspices.

The studies on soil problems, particularly the relation between vertical distribution of soil and the rooting of plants as well as the studies of the soil column, were continued.

On the farm at Davis the irrigation work in cooperation with this office was continued and experiments in crop rotations, including alfalfa, and on orcharding under irrigation were carried on. Pot work was in progress to determine the amount of water required to make a pound of dry matter of alfalfa, barley, and wheat. The work with cereals consisted of testing varieties and of plant breeding by the centgener method on a rather extensive scale with barley, wheat, and oats. Some work was also begun with various leguminous plants.

In southern California the investigational work was principally carried on at Whittier and Riverside. In addition to the Adams fund work mentioned above the relation of various enzymes to gummosis was given attention, and in connection with the study of metabolism of the rind of oranges and lemons, analyses were made at all stages of growth to determine the possible relation of starch content in the rind to the disease known as brown spot. Field observations and soil examinations were made to determine the possible significance of soil moisture and underlying hardpan as factors in the mottled leaf disease of citrus trees. The little leaf disease of peaches and grapes also received attention, and spraying experiments for the control of walnut blight and *aphis* were in progress. Investigations were further made on tomato wilt and blossom-end rot and also on the brown streaking of potato tubers. Work on the determination of the cause of red rot of the lemon was nearly completed. At Riverside the fertilizer work was continued as previously pursued and experiments were made on the control of withertip by spraying with lime-sulphur and Bordeaux mixture. The use of smudge pots in frost prevention and the growing of cover crops were also given consideration.

The forestry work at Santa Monica was carried on along the same lines as those previously described and consisted largely of tests of grafting species of eucalyptus and other varieties of trees.

The publications received from this station during the year were as follows: Bulletins 212, California White Wheats; 213, The Principles of Wine Making; 214, Citrus Fruit Insects; 215, The House Fly in Its Relation to Public Health; 216, A Progress Report upon Soil and Climatic Factors Influencing the Composition of Wheat; 217, Honey Plants of California; 218, California Plant Diseases; 219, Report of Live Stock Conditions in Imperial County, California; 220, Dosage Tables; 221, Commercial Fertilizers; 222, The Red or Orange Scale; 223, The Black Scale; 224, The Production of the Lima Bean—The Need and Possibility of Its Improvement; 225, Tolerance of Eucalyptus for Alkali; 226, The Purple Scale; 227, Grape Vinegar; 228, New Control Methods for the Pear Thrips and Peach Tree Borer; Circulars 60, Butter Scoring Contest, 1910; 61, University Farm School; 62, The School Garden in the Course of Study; 63, How to Make an Observation Hive; 64, Announcement of Farmers' Short Courses for 1911 at the University Farm, Davis, Cal.; 65, The California Insecticide Law; 66, Insecticides and Insect Control; 67, Development of Secondary School Agriculture in California; 68, The Prevention of Hog Cholera; 69, The Extermination of Morning-Glory; 70, Observations on the Status of Corn Growing in California; 71, Grains Recommended for Trial; 72, Salt in Cyanids; 73, Pure Insecticides; 74, Rice—A Possible New Industry for California; 75, A New Leakage Gage; 76, Hot Room Callusing; and 77, University Farm School.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000
United States appropriation, Adams Act.....	15,000
State appropriation.....	125,275
Fees.....	12,000
Farm products	2,000
Total.....	169,275

The California stations are pursuing the study of a wide range of problems representing the diversified interests of the State. The broadening of their organization which is at present going on, coupled with liberal State aid, should bring about further good results.

COLORADO.

Agricultural Experiment Station, Fort Collins.

Department of the State Agricultural College of Colorado.

C. P. GILLETTE, M. S., *Director.*

The year at the Colorado station was one of general improvement. An extensive field laboratory for work in irrigation and hydraulics, to afford exceptionally complete facilities for studies in these lines, was in process of construction.

Good progress was made in pursuing the lines of work carried on under the Adams fund. The work of the chemist was devoted very largely to the study of nitrates in Colorado soils and their effect upon the development and sugar content of the sugar beet. The work on this project was practically concluded, and an extensive bulletin on the subject giving a detailed account of the work was issued. Under the favorable conditions prevailing of high temperature and abundant moisture, it was found that nitrates accumulate in the soil rapidly, excessive and injurious amounts being produced. The presence of an undue amount of nitrates in the soil produces a disproportionate growth of foliage in the sugar beet, and a consequent reduction in the quality of the beet for the manufacture of sugar. It was shown that this condition brings about a smaller percentage of crystallizable sugar and a larger percentage of noncrystallizable sirups in the beet. Leaf spot of the beet (*Cercospora beticola*) seemed to have no further deleterious effect upon the quality than that produced by the reduction of the leaf surface.

In connection with this project the bacteriologist has studied nitrogen fixation, ammonification, and nitrification, the first two subjects being completed. The results of work on the ammonifying efficiency of certain Colorado soils published during the year pointed out that many of the cultivated soils of the State have the power to transform organic nitrogen into ammonia, and that the so-called nitrate soils excel in ammonifying efficiency to a very marked degree. In connection with this work it was found that algæ occur abundantly in many cultivated soils of Colorado, the forms possessing thick gelatinous sheaths predominating, and that these may be considered as a source of energy for the activity of the nitrogen-fixing organisms. Work was also done on pigment to determine the cause of the brown color shown by soils containing a large amount of nitrates.

The experimental work in irrigation and allied subjects had reference mainly to the flow of water, the coefficient of friction in the empirical formulas, and to drainage requirements of crops and drainage factors. Systematic studies were made on the evaporation of water from a free surface in the effort to work out a formula. Some of this work, including the study of weir construction, was temporarily suspended during the year owing to inadequate facilities for its prosecution, and the completion of the hydraulic laboratory will aid greatly in the progress of these investigations.

The studies on plant lice were continued, and important data on life histories were obtained. A large number of specimens for study were collected and preserved in alcohol or in balsam. The studies were devoted largely to species of *Schizoneura* infesting the apple, elm, and hawthorn, and to the sugar-beet aphid. For several forms the life history has been completed ready for publication.

No work was done on the study of the black root of the strawberry, and the project was abandoned.

With Hatch and other funds the agronomist had in progress a large amount of work at the station and in other parts of the State. The work with grains at Fort Collins consisted of studies on the interrelation between yielding power and length of head, yield per plant, stoebling, size of grain, and similar factors. Breeding experiments were made with alfalfa, and attention was given to hardiness of type, fixedness of strain, and to value for seed and hay production. Some of the work was done at altitudes of 7,500 to 8,000 feet for the purpose of determining a possible influence on correlation as compared with the altitude of 5,200 feet at Fort Collins. Observations on the normal seed variation in three fall and two spring varieties of wheat and in barley, oats, and brome grass were continued, the past year being the third of the experiments. At Rocky Ford, 15 acres were devoted to nursery and plat work with alfalfa. Some improved strains resulting from this work were distributed to farmers. It was observed that a decided relation existed between the type of the crown and its tendency to winterkill. The hardy strains had spreading crowns with underground root stocks and shoots, with buds protected by soil from winter freezing, while the nonhardy strains had more upright stoebling crowns with the bud areas very near the surface exposed to winter freezing, drying, and thawing. Work on varieties and culture of high altitude crops and experiments in dry farming were discontinued for the year on account of the lack of State funds.

The horticulturist enlarged the experimental orchard and studied plant diseases, giving special attention to peach spot and its control with Bordeaux mixture. An attempt was made to determine the cost of thinning apples and the dates of blooming of different varieties, and efforts were put forth to secure Northern Spy trees on their own roots for top-working with ordinary commercial sorts. Other lines of activity included work with onions, cabbage, strawberries, and cherries.

In animal husbandry experiments were made to determine the value of alfalfa meal in feeding hogs and the results showed the meal to be a profitable addition to a grain ration when it is necessary to supply protein. With steers an experiment was finished up on the cost of beef production, using calves from range cows. The results demonstrated the feasibility of finishing steers in the mountain valleys instead of selling them as feeders.

In entomology work was done on the life history of grasshoppers and of the fruit-tree leaf-roller, and studies were made of the bean beetle and the tomato psyllid. The value of oil sprays for the destruction of the eggs of the fruit-tree leaf-roller and the definite periods for the most successful application of arsenical poisons to combat the larvæ were worked out. The spraying experiments were carried on in a station orchard for the purpose.

The irrigation work in addition to that carried on under the Adams fund consisted of studies on pump irrigation, the use of concrete structures, water requirements of crops, irrigation conditions in the San Luis Valley, orchard irrigation of Canon City, and on meteorological conditions at Fort Collins, together with the establishment of three 40-acre experiment farms in the San Luis Valley.

The horse-breeding work conducted in cooperation with this department included about 80 animals, and some of the progeny developed conformed admirably to the desired type. The work is supported on a cooperative basis by the station and this department.

The publications received from this station during the year were as follows: Bulletins 150, On the Measurement and Division of Water; 168, The Deterioration of Manures Under Semiarid Conditions; 169, Some Insects and Mites Attacking the Peach in Colorado—Two Plant Lice of the Peach; 170, Thinning of the Winesap; 171, The Colorado Raspberry Industry; 172, Garden Notes, 1910; 173, Notes on a Dry Land Orchard; 174, Adobe as a Building Material for the Plains; 177, Hold-over Blight in the Pear; 178, The Fixation of Nitrogen in Some Colorado Soils; 179, Bacteriological Studies of the Fixation of Nitrogen in Certain Colorado Soils; 180, pt. 2, Seepage and Return Waters—Detailed Measurements—The Cache la Poudre; 181, Alfalfa—The Relation of Type to Hardiness; Circulars 10, Preparation of New Land for Crops; 11, Flax Growing; and the Annual Reports for 1910 and 1911.

The income of the station for the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	11,250.00
Miscellaneous.....	14,182.56
Total.....	55,432.56

The Colorado station is making good progress and is well administered. A permanent State appropriation would materially strengthen it. The station is working for the various sections and agricultural interests of the State, but its work might profitably be extended in several lines if funds were available.

CONNECTICUT.

The Connecticut Agricultural Experiment Station, New Haven.

E. H. JENKINS, Ph. D., *Director.*

The personnel and work of the Connecticut State station changed but little during the past year, but since its close W. O. Filley was appointed State and station forester, to succeed S. N. Spring, who resigned to take charge of forestry work at Cornell University, and a few changes occurred in the minor positions. Director E. H. Jenkins

was also given the directorship of the Connecticut Storrs station, the two stations henceforth to be under one head.

Improved quarters were provided for the station library, and work was continued in putting the recently acquired 20-acre tract into condition for experimental work. At this farm apple and peach orchards and a forest nursery have been established, and the plat work inaugurated includes experiments in plant breeding, culture, and rotation of crops, and the use of lime.

Among the Adams fund projects progress was reported on the study of the nutritive value of plant proteids. The investigations on this subject followed lines of previous years under the continued grant of the Carnegie Institution and the collaboration of Dr. L. B. Mendel, of the Sheffield Scientific School. A fair measure of success was attained in feeding white rats on pure chemical rations, and data were obtained indicating that certain of the pure proteids possess little or no nutritive value, others sustain life but do not produce growth, and still others produce growth and have a high nutritive value. Some of the proteids which separately had little or no nutritive value were found of pronounced value as food when fed in combination.

It was shown that uniformity of diet over periods of one to two years in itself offers no difficulty in nutrition experiments with rats. These investigations include the first feeding experiments on record in which a satisfactory growth was maintained by chemically prepared nutrients and artificially prepared mineral mixtures. Normal rate of growth was induced in white rats with dietaries devoid of fat throughout almost the entire period during which growth ordinarily continues. More than 20 single proteins have been tested as to their ability to meet the nitrogen requirements of growing rats. It was found that many of these, including proteins of the most diverse origin and composition, satisfy the requirements fairly well, while others as phaseolin, zein, gelatin, and conglutin, wholly failed to meet the needs of growth. A series of articles bearing on this work was published in various scientific journals during the year.

The breeding experiments with corn, particularly reported upon in Bulletin No. 168 of the station, were continued along the original lines, and the results have shown among other facts the commercial importance of taking advantage of the increased vigor of first-year crosses. Studies of first generation hybrids of tomatoes were also made. The work with tobacco, especially extensive and complete, was carried on at the station farm at Mount Carmel and at various other points. The characters studied in particular were number of leaves per plant, height of plant, average area of leaf, and length and breadth of leaf. In addition to studying the influence of crossing on these factors, studies were made of how and to what degree the resultant characters may be fixed.

A study was also made of the effect of selection within a self-fertilized family of tobacco grown on three different types of soil. Twelve selections of the F_3 generation of a cross between Broadleaf and Sumatra, apparently nearly fixed, were grown, cured, and fermented, with a view to determining their actual value for commercial purposes. A report upon the tobacco-breeding work was made in Bulletin 171 of the station, and the results there presented are stated to be entirely in accord with the Mendelian interpretation of quantitative characters.

The studies on zenia in maize, continued at the station and elsewhere, gave results without exceptions to Mendelian interpretation. This work was reported upon in a bulletin and in the annual report of the station.

In addition to the investigations mentioned above, other lines of work, supported by the Hatch and State funds, were carried on. The botanist continued work on potato blight, giving particular consideration to the organism causing the disease, and conducted experiments on the calico disease of tobacco, the nature and botanical relations of chestnut blight, and on disease resistance in certain plants. The studies on peach yellows were continued in an orchard treated with different fertilizer combinations and where attention was also given to the influence of fertilizers and cover crops, on winter injury, and on the growth, yield, and productive life of peach orchards. Other work included variety tests of melons and spraying experiments in cooperation with the entomologist to determine the effects of different sprays on apples and peaches.

The entomologist, who is also State entomologist, carried on a large amount of work, including extermination of the gypsy and brown-tail moths, nursery and apiary inspection, studies of the life history of the walnut weevil and treatment of the insect with lead arsenate, studies of new species of the walnut budworm, the blackberry sawfly and white-pine weevil, and other insects. Considerable work was done in connection with mosquito control, as a result of which a large acreage of salt-marsh area of the State has been drained. Effective methods of draining and oiling were demonstrated, and the cost of draining per acre was determined.

Forest planting experiments were carried on at Windsor, and a survey of woodworking industries in the State was continued. The station forester is also State forester and has charge of the State forests, which have now been established in eight counties. As a result of the forestry work larger areas are devoted to forest-tree planting on lands not so well adapted to other purposes, and better protection against forest fires is assured.

The inspection work of the station was large, as in previous years, and included, as heretofore, fertilizers, feeds, foods, and drugs, as

well as nursery and apiary inspection already noted. In connection with the inspection work the chemist devised an improved method of determining starch in meat products.

The publications received from this station during the year were as follows: Bulletins 169, The Leopard Moth; 170, The Trade in Cotton-seed Meal; 171, Correlation and Inheritance in *Nicotiana tabacum*; Annual Report for 1909-10, pt. 12, Tests of Garden and Field Seeds, 1910; Annual Report for 1911, pts. 1, Report on Commercial Fertilizers, 1911; 2, Sixteenth Report on Food Products and Fourth Report on Drug Products, 1911; 3, Commercial Feeding Stuffs, 1911; 4, Eleventh Report of the State Entomologist, 1911; and 5, Tests of Summer Sprays on Apples, Peaches, etc.

The income of the station for the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$7,500.00
United States appropriation, Adams Act.....	7,500.00
State appropriation.....	18,500.00
Individuals.....	14,019.88
Fees, including balance from previous year.....	11,503.87
Farm products.....	386.99
Miscellaneous.....	366.21
Total.....	59,776.95

The Connecticut station has steadily developed important lines of investigation, particularly in plant breeding and the study of the composition and nutritive value of plant proteids. Increasing attention is also being given to making practical application of the results of the station work.

Storrs Agricultural Experiment Station, Storrs.

Department of the Connecticut Agricultural College.

E. H. JENKINS, Ph. D., *Director.*

The changes of special importance in the personnel of the station during the past year were the appointment of J. N. Currie as chemist of the cheese investigations, of W. F. Kirkpatrick of the Mississippi station as successor to F. H. Stoneburn, poultryman, and of H. J. Bower as agronomist in college and station. State appropriations are available for new buildings to provide increased facilities for work in agronomy, dairy husbandry, poultry husbandry, and animal industry. Progress was made in preparing the land turned over to the station by the college for experiments in agronomy. This land was drained, so managed as to bring it to as high a degree of uniformity as possible, and for experimental purposes 126 twentieth-acre plats were laid off.

No new Adams fund projects were undertaken during the year, but the investigations in hand were actively pursued. The study of fermentation of silage was completed and the results reported in

Bulletin 70. In this investigation a study was made of changes in temperature, acidity, and fermentation processes at different times and at different depths, in an ordinary silo filled with corn and various mixed crops. The study directed attention to the very complex combination of different fermentations in the process of silage formation in which the lactic acid and yeast fermentations appeared to be the most important agents concerned. It was found that silage juice containing all the sugar and only soluble proteins was fermented into typical silage acids or silage vinegar by the same organisms that work in the silage.

The general conclusion drawn was that the fermentation of corn silage is essentially the change of sugar into several acids, the most important change being the conversion of a part of the sugar by lactic-acid bacteria into lactic acid. A secondary change was found to be produced by the action of yeasts on the remaining sugar, changing it to alcohol, while the acetic bacteria changed the alcohol into acetic acid. Mixtures of alfalfa and rye, clover and timothy or wheat or oats, oats and peas, and corn and cowpeas or soy beans were found to silo successfully and to make a very desirable and nearly balanced ration.

The investigations on soil biology were directed mainly to a study of the depth of greatest bacterial activity, and the relation of moisture, humus, lime, fertilizer, and methods of culture thereto, some of the work being done on soils of the college farm and some on soils on farms in different parts of the State. Studies on the character, classification, and activity of bacteria in frozen soils were continued. A bulletin on soil fertility embodying the results of these investigations was in the course of preparation.

The projects relating to disease resistance in melons and breeding beans for disease resistance were interfered with by the loss of seed and the inability to obtain land for the work at the proper time. With a view to continuing the experiments and to verifying previous results, the work the past season was largely devoted to the production of further pure-line stock.

The status of the cheese investigations carried on in cooperation with this department remained unchanged during the year and were confined principally to the green-mold types, more particularly to a study of the ripening process in Roquefort cheese. A chemical study was made of the changes in the fat in the process of ripening, giving rise to the characteristic taste of this cheese, and of the relation of the fat of sheep's milk to this taste. Analyses were also made by means of specially devised apparatus of the gas in cheese. A good quality of cheese of Roquefort type was made without addition of sheep's milk, as in the European process. In connection with these investigations, work on *Aspergillus* and *Penicillium* was continued.

In the work on the relation of bacteria to the hen's egg, attention was given during the year to a study of respiration or carbon-dioxid production in artificial incubation, more particularly to the construction of a special form of simple respiration calorimeter for the purpose. Some study was also made of carbon-dioxid production in natural incubation under hens.

The study of white diarrhea in chicks continued to be the largest and most important line of investigation under the research fund, and the organization of the work was the same as in previous years. The phases of the subject studied in particular were the transmission of the disease by adult fowls, the possibility of infection at other than the very early stages of growth, and the checking of the disease in chicks by means of acid food, particularly sour milk.

A number of lines of work supported from the Hatch fund were conducted separate and distinct from the Adams fund projects. In horticulture, experiments in spraying melons and cucumbers were continued and Bulletin No. 72 of the station on this subject was issued. Melons were grown from selected seed for the purpose of obtaining a strain resistant to blight or downy mildew, and experiments were conducted in spraying tomatoes for leaf blight and in forcing and in testing varieties of vegetables. Observations were also made on the behavior of fruit trees under various methods of orchard management and on different methods of renovating neglected apple trees.

In dairy husbandry, feed and milk records of the college herd were kept as heretofore and experiments with high and low protein rations were continued. Attention was also given to business methods of making and selling ice cream.

The international egg-laying contest, requiring 50 houses and 100 pens, each capable of accommodating six hens, was successfully carried on at the station during the year under State funds. Experiments in raising quail in cooperation with the State game commission were continued. On restricted range, the birds proved very susceptible to an intestinal disease which was studied to determine its specific cause.

The publications received from this station during the year were as follows: Bulletins 69, New England Trees in Winter; 70, Silage Fermentation; 71, Some Apple Insects of Connecticut; and the Biennial Report for 1910-11.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$7,500.00
United States appropriation, Adams Act.....	7,500.00
State appropriation.....	3,875.00
Miscellaneous, including balance from previous year.....	1,899.15
Total.....	20,774.15

The Storrs station adheres to the wise policy of concentrating its efforts upon a few well chosen lines, which it endeavors to develop to the fullest extent.

DELAWARE.

The Delaware College Agricultural Experiment Station, Newark.

Department of Delaware College.

H. HAYWARD, M. S. Agr., *Director.*

The Delaware station during the past year recorded steady progress in its work. Changes in the staff, other than those heretofore noted, were few, and the general activities of the station went on uninterrupted. A State appropriation of \$5,000 was used in completing some of the buildings on the college farm and in the erection of a new dairy building (Pl. II, fig. 1).

The investigations under the Adams fund were carried on satisfactorily and the facilities for the work on the different problems were increased, a new laboratory being one of the chief additions. The study of the relation of parasitic fungi to the contents of the cells of the host plants was brought to a close, and a second paper on the subject treating specifically of the toxicity of vegetable acids and the oxidizing enzym was prepared for publication. The toxicity of vegetable acids was found to vary with the organisms used, tannic acid being the most toxic. The enzym in vegetable juices, which acts on gallic acid and forms a tannin or tanninlike body, was observed to decrease with the maturity and ripening of the fruit and the power of resistance to parasitic organisms was decreased proportionately. Chemical tests of apples and pears made throughout the season indicated a decrease in the oxidizing power of the enzym, a slight increase in acids, and a pronounced increase in the amount of sucrose. The results secured with persimmons were similar with the exception that the decrease in oxidizing power of the enzym was more pronounced and that instead of a slight increase in acids there was a slight decrease.

Investigations on the apple and the peach were continued as heretofore, and improvements in the methods of conducting the work were made (Pl. II, fig. 2). Studies of the first crop from the experimental peach orchard were pursued and considerable chemical work in connection with the project was done. The experimental apple orchard had not reached bearing age.

The work of the chemical department was principally with reference to the sugar content of fruit juices, more especially those of strawberries, peaches, pears, grapes, and apples. The laboratory work was very much facilitated by an apparatus designed in the laboratory for polarizing at high temperatures and obtaining under these conditions without difficulty a full, clear field, thus affording accurate

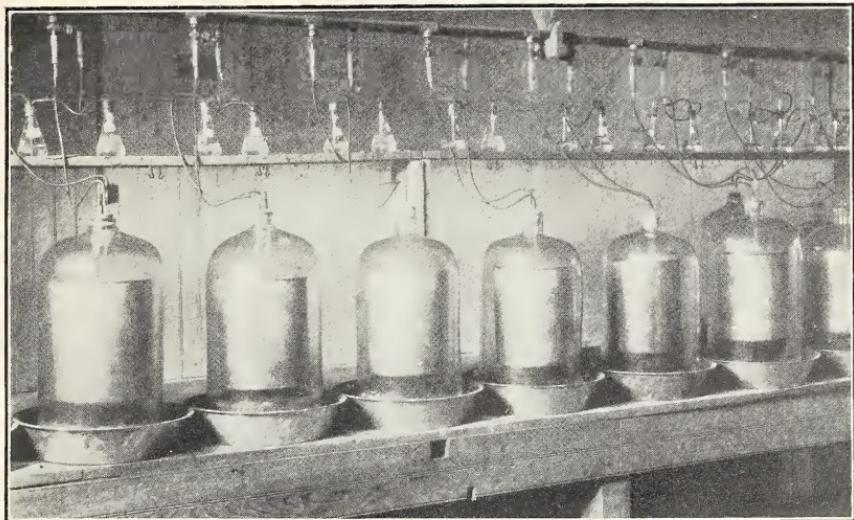


FIG. 1.—APPARATUS FOR STUDYING THE DECOMPOSITION OF ORGANIC MATTER IN SOILS,
DELAWARE STATION.

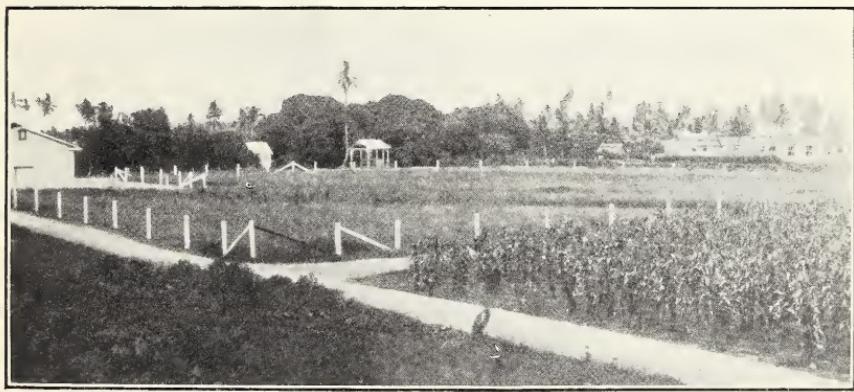
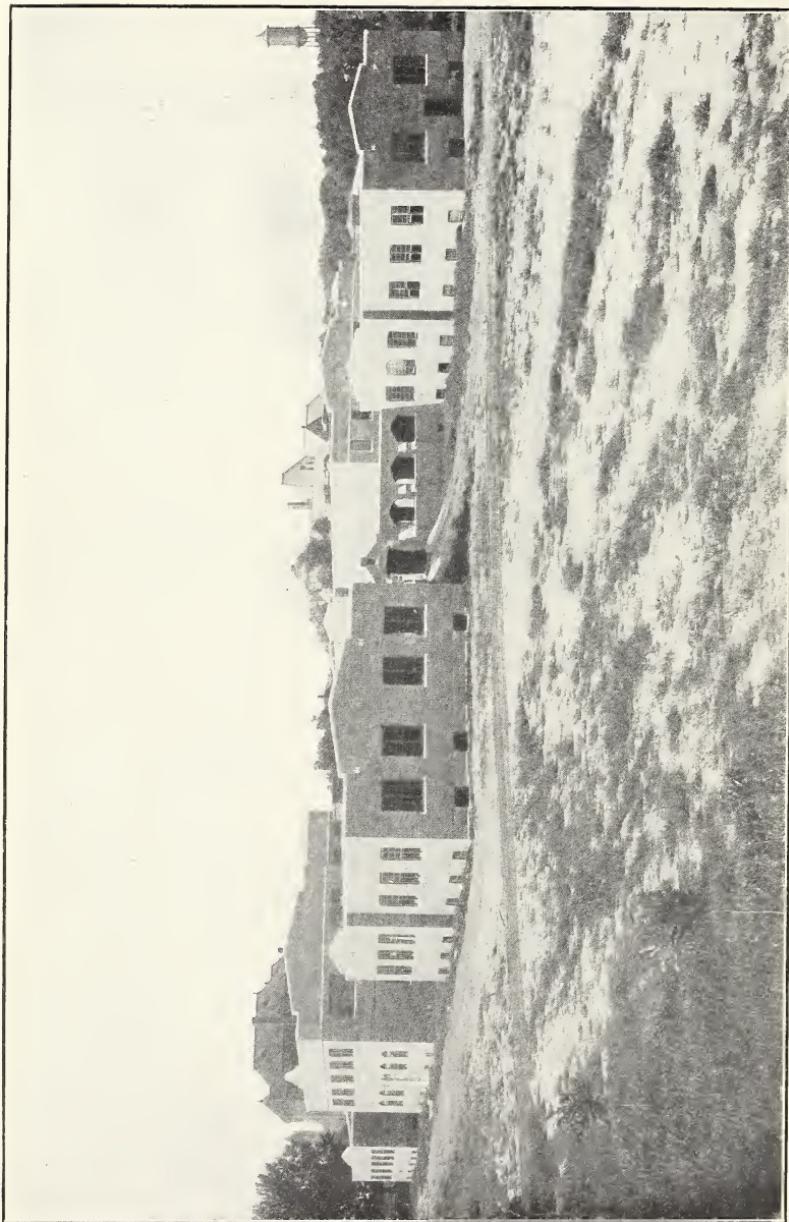


FIG. 2.—PARTIAL VIEW OF GROUNDS, GUAM STATION.

An. Rpt. Office of Experiment Stations, 1912.

PLATE IV.



NEW VETERINARY BUILDING, IOWA STATION.

readings. It was found that the dominant type of sugar varies very much in the different fruits. During the winter the work of this department was confined largely to an investigation of lime-sulphur solutions with a view to determining the reactions taking place under varying conditions and at certain points in their preparation.

Three years' results, together with complete analyses of grain and straw, were completed in the study on the response of various types of wheat to different kinds and quantities of plant food. The relation of the chemical composition of different varieties to the various plant-food elements in the soil was investigated and studies were continued with nearly 100 varieties to determine the value of tillering as a variety character. The results of work with corn did not indicate a wide range in yield from different physical characters. Supplementary to this work more than 2,000 ears of corn were measured with a view to determining some of the more important correlations of ear characters, and incidentally some light was also thrown on the relations of weight in shelled corn.

The results of a laboratory study (Pl. III, fig. 1) indicated, among other things, that ground limestone is as effective as burnt lime in promoting decomposition of organic matter and the availability of nitrogen. The study of certain phases of the relation of different forms of lime to some of the mineral elements of the soil was continued.

With Hatch funds the department of agronomy made observations on the effect of different rotations upon the fertility of the soil and on the commercial returns from different systems of cropping. Eighteen different rotations entered into these experiments. Comparisons were made of 35 varieties of corn and of 60 varieties of wheat as to yielding capacity, disease resistance, and general adaptability. With wheat, the effect of various phosphates, green manure, and lime, together with the general plant-food requirements, and with corn the value of various leguminous crops for green manuring and of different substances as carriers of phosphoric acid were studied. The place of corn in different crop rotations also received consideration. An ear-to-row method of testing 40 ears of Johnson County white corn was begun as a basis of breeding work, and several hybrids were tested during the season. Similar experiments were in progress with oats, cowpeas, and soy beans. A bulletin reporting culture and variety tests with soy beans, together with the results of analyses showing the oil and protein content in the grain of 51 varieties, was issued during the year.

Among other lines of work the horticulturist conducted varietal studies with potatoes, tomatoes, peaches, apricots, plums, cherries, apples, pears, quinces, grapes, currants, gooseberries, blackberries, and raspberries, and compared different cover crops for peach and apple orchards. In peach orchards soy beans, cowpeas, and oats

seemed to be especially valuable as cover crops. A study was made of the effect of various spray mixtures on the foliage of the peach, and work on the injury of Bordeaux mixture in spraying apple trees was completed and the results summarized for publication. Fertilizer tests were made with potatoes and tomatoes and a continuous cropping experiment with early potatoes was in progress. The work on the fertilizer requirements of tomatoes has now been in progress for three years and can not be completed until a greenhouse is provided. The breeding and selection of tomatoes was also continued.

The department of agronomy carried on a number of extension and cooperative experiments in various sections of the State with corn, alfalfa, and soy beans. The department of horticulture, with the aid of State appropriations, had under way a number of cooperative experiments in various parts of the State, including, among other work, a study of the strawberry interests of Delaware, of the tomato industry of the State, and of orchard cover crops adaptable to Delaware conditions. The veterinarian cooperated with this department in pursuing the study of a problem concerning calf pneumonia.

The following publications were received from this station during the year: Bulletins 94, Annual Report of the Director for the Fiscal Year Ending June 30, 1911; 95, Top-dressing Grass Lands; Circulars 4, Farmers' Day Guide; 5, Farmers' Day Guide; and 6, Farmers' Day Guide.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products.....	3,060.27
Total.....	33,060.27

The work of the Delaware station is progressing well and its outlook is promising. It has profited to a considerable extent by the financial aid extended by the State but its needs have not been fully covered.

FLORIDA.

Agricultural Experiment Station of Florida, Gainesville.

Department of the University of the State of Florida.

P. H. ROLFS, M. S., *Director.*

A number of changes on the staff affected the work of the Florida station to some extent during the past year, but provision was made for continuing the experiments in progress and thus to minimize the usual effects of changes in personnel. A. W. Blair, chemist, resigned to take a position with the New Jersey stations, and H. S. Fawcett, plant pathologist, who resigned to take up work at the California station, was succeeded by H. E. Stevens.

Satisfactory progress was made on all Adams fund projects with the exception of the study of pineapple wilt, which was temporarily suspended. The study of soils and fertilizers in relation to the development and growth of the orange tree was continued as previously noted in the experimental orchard near Tavares on Lake Harris and in soil tanks at the station. The study of the trees at the station was enlarged by the addition of four tanks. Chemical studies were made of the soil drainage water and of parts of the trees growing in the tanks, and the differences in the rate and amount of leaching were determined for different fertilizers and plant food elements. The amount of potash lost by leaching was small as compared with the ammonia, and the amount of phosphoric acid found in the drainage water was extremely small. The effect of various fertilizer combinations, particularly different kinds of nitrogenous substances on oranges, both in health and disease, was also studied.

In addition to the above work by the chemist, the plant physiologist pursued studies in the greenhouse and the laboratory, including the study of the raw materials and the changes they undergo after they have been absorbed by the plant, and of the changes in the tissues and cells resulting from various methods of feeding under different conditions. Studies were also made in citrus groves in different parts of the State. The work at Tavares was seriously interfered with by a serious attack of die-back on the trees of the experimental orchard.

In connection with further studies of citrus diseases, an attempt was made to determine the amount of certain fertilizers required to produce certain supposed physiological or malnutrition disorders, such as die-back, yellow spotting, and frencing. The studies on melanose, heretofore considered a physiological disease, gave results indicating very strongly that this is a pathological disease, and its further study was transferred to the plant pathologist. The principal work of the year consisted of studies on stem-end rot and gummosis of citrus fruits. Climatic conditions were unfavorable to the development of stem-end rot, and the data secured were consequently somewhat meager, but it was shown quite conclusively that the stem-end rot fungus (*Phomopsis citri*) is to a considerable extent dependent on the presence of scale insects as well as on favorable climatic conditions for the infection of fruits. Work on this disease with the exception of further work on methods of control was largely completed. On gummosis, the object was the discovery of the causative organism of one form of the disease and the conditions necessary for infection. Success attended the attempt to produce the die-back disease in the greenhouse under controlled conditions of heat, light, and moisture. Valuable data on the relation of

organic nitrogenous fertilizers to the disease were secured. Studies of the gum formation association with die-back indicated that at least two enzymes are concerned in the development of the lacunæ and the gum pockets.

Notable progress was made in the plant-breeding project, and the work was again largely centered on the hybridization of the Florida velvet bean and the Lyon velvet bean and on the study of several segregated strains found to possess unusual promise for production in the State. One of these strains appeared fairly constant and produced a large quantity of seed earlier than the Florida velvet bean. The study of the inheritance of characters and efforts to isolate a smooth-podded race of beans of a nonshattering type were continued. A method of competitive planting was used with good results in eliminating weak or undesirable strains. In crossing corn the work was seriously interfered with by heavy rains during the past season.

The work on the white fly was restricted very closely to a study of conditions controlling natural mortality and of the limitations of spread of the woolly white fly (*Aleyrodes howardi*), probably introduced from Cuba. It was determined that the mortality of the white fly during the period of development often reaches 50 per cent and is sometimes even greater. From the studies made it was clearly shown that a fungus popularly known as the white fly fringe fungus was the cause of this natural mortality, but that it was unable to produce a sufficient amount of mortality to make it useful as an agent for combating the pest. A study of the woolly white fly showed that this insect is also very heavily parasitized, as high as 74 per cent of the insects examined being killed in this way.

In the work on vegetable diseases considerable time was devoted to the study of the cucumber disease affecting the leaves and causing the fruit to become misshapen and to be affected with more or less translucent spots. The results of the study indicated that the disease is due to an apparently undescribed bacterium belonging to the genus *Pseudomonas*. A bacterial disease of lettuce was also studied.

Important experiments were also conducted with the Hatch fund. In animal husbandry the station completed the past year the comparison of the development of native and grade stock begun in 1908. Originally five cows each were bred to native Hereford and Shorthorn bulls, and the best two animals in each lot of the progeny selected at the end of the first year were entered into a feeding test the past season and their differences in beef-producing capacity and other characters determined. Special stress was laid on experiments with pigs in feeding various home-grown products alone or in combination with milk and other substances. The dairy herd of the station was increased by four pure-bred heifers. Studies in milk production with

the use largely of introduced and native forage plants for feed were also in progress.

Experiments with plant introductions were continued and further promising results were recorded. Rhodes grass (*Chloris guyana*) is considered as having passed the experimental stage, and a large quantity of its seed is desired for seeding in the State. Yokohama velvet bean (*Stizolobium hasjo*) was found to mature its seed in about four months, a feature which makes it an important acquisition and adapts it to growth as a second crop on land that has already produced some agricultural product during the year. The Chinese velvet bean (*Stizolobium* sp.) proved well adapted to Florida conditions. Its seed matured about the middle of October, and its range was found to extend much farther northward than that of the Florida velvet bean. It has a further advantage over the Florida velvet bean in that it matures its seed early enough to escape the ravages of the velvet-bean caterpillar. The distribution of the Lyon velvet bean throughout the State was continued. Experiments were also conducted in corn and cotton breeding and with cowpeas and soy beans, especially good results being obtained with Iron and Brabham cowpeas.

In entomology particular attention was given to the use of insecticides, such as crude oil and other sprays. In the test of insecticides it was found that crude oil reduced and lime sulphur increased the size and earliness of oranges. Some work was undertaken in importing lady beetles from the Pacific coast, and observations on the distribution and injury from thrips were made on the east coast of the State.

Many varieties of vegetables, including among others eggplants, peppers, tomatoes, and sweet corn, were tested to determine their merits and adaptability to the State. Much attention was also given to tests of miscellaneous plant introductions in cooperation with this department. Seeds of some of the more promising crops were distributed through the extension department.

The publications received from this station during the year were as follows: Bulletins 107, Stem-end Rot of Citrus Fruits (*Phomopsis* sp.); 108, Diseases of Citrus Fruits; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products.....	2,512.27
Balance from previous year.....	350.42
Total.....	32,862.69

The Florida station is well organized, and its various activities are efficiently directed and managed. It is giving much assistance to the specialized industries of the State and has a loyal following.

GEORGIA.**Georgia Experiment Station, Experiment.¹**

Department of Georgia State College of Agriculture and Mechanic Arts.

M. V. CALVIN, *Director.*

There were practically no changes at the Georgia station during the year in organization or personnel, and most of the lines of work pursued were continuations of previous activities. Near the close of the year a poultry department was established, and A. F. Rolf, who came from the Mississippi station, was placed in charge of the work.

Progress was made in most of the Adams fund work of the station during the year. The discontinuance of the position of animal pathologist and veterinarian forced the abandonment of projects entered upon but not completed, and only brief and inconclusive statements regarding the subjects under investigation resulted from the work. Very little progress was made in the project on the protein requirements of growing dairy cattle. The entomologist practically completed the project on the mole cricket and the preparation of a bulletin on the work was in progress. The study of the chemistry of the cotton plant was extended to the mineral constituents of the seed.

Careful and systematic work was done in studying Mendelian inheritance in cotton hybrids and a bulletin was published on the subject. In the crosses studied 30 or more pairs of heritable characters appeared to obey Mendel's laws of dominance, segregation, and recombination. Variations of economic importance were found to be of frequent occurrence. Artificial crossing with subsequent selection, according to the Mendelian method, was recommended as the quickest means for the production of new strains.

The work on the influence of barnyard manure on the bacterial flora of the soil, which was in part reported upon in Bulletin 95, was continued with reference to phases other than those previously studied. In the study of the blossom-end rot of the tomato, the bacteriologist and horticulturist cooperated and practically completed the project during the year, the results being published in Bulletin 96. It was concluded that the disease is a physiological disturbance due to insufficient water supply. The malady proved to be noninfectious and nonresponsive to crop rotation, destruction of attacked fruits or spraying being the means for its control. Keeping an abundant supply of water in the soil was apparently the most efficient method of controlling or preventing the trouble. The bacteriologist and horticulturist also pursued work on the plum wilt cooperatively, and carried the project well forward toward completion.

In connection with the grape-breeding project the horticulturist is growing about 1,000 seedlings of Muscadine grapes for use in correlation and other breeding studies.

¹ Telegraph, freight, and express address, *Griffin.*

The Hatch-fund work of the station included under agronomy the usual experiments with cotton and corn. The results of three years' work with these crops, covering tests of varieties, fertilizers, and methods of planting and cultivation, were summarized and published in Bulletins 97 and 98. In experiments with wheat and oats, special attention was given to comparative tests of nitrogen applied to the soil in the form of cottonseed meal, tankage, dried blood, ammonium sulphate, and sodium nitrate. Comparisons were also made of fine-ground phosphate and acid phosphate and the effect of dynamiting land was tested. Selections were made of varieties of cotton resistant to anthracnose, and tests of light and heavy seed corn conducted in cooperation with this department were in progress.

The horticulturist carried on a large amount of work, including tests of varieties, the breeding and thinning of peaches, and comparative tests of arsenate of lead and self-boiled lime-sulphur for curculio and brown rot of peaches. Among Elberta peach seedlings now fruiting one was found about a week later in maturing than the ordinary Elberta. Tests were made of varieties and thinning of plums and of several varieties of apples. Observations were made on apples under clean culture and in sod in their relation to blight and the crown gall of apples was also given attention. Dwarf and standard varieties of pears were planted for the study of blight resistance and observations were made on several varieties of pecans to determine their relative merits. Variety and culture tests of tomatoes, potatoes, and sweet potatoes were in progress, especial attention being given to the growing of fall tomatoes and to the effect of fertilizers on sweet potatoes and on the physical properties of the soils on which they were grown. An acre was devoted to the culture of Japanese wood oil in cooperation with this department.

In animal husbandry simple feeding experiments were conducted with pigs and dairy cows, the work with dairy cows being concluded during the year.

The publications received from this station during the year were as follows: Bulletins 95, The Influence of Stall Manure upon the Bacterial Flora of the Soil; 96, Tomatoes; 97, Corn Culture; 98, Cotton Culture; Circular 67, Variety Test of Corn and Cotton, 1911; and the Annual Reports for 1910 and 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	620.81
Farm products.....	5,471.71
Balance from previous year.....	5,958.65
Total.....	42,051.17

The Georgia station has important lines of work in progress which should give results of value to the State, but conditions are not such as to conduce to a high order of efficiency, and have become more unsettled during the year. Radical change in administration and the policy of management is greatly needed.

GUAM.

Guam Agricultural Experiment Station.

Under the supervision of A. C. True, Director, Office of Experiment Stations, United States Department of Agriculture.

JOHN B. THOMPSON, B. S., *Special Agent in Charge.*

The completion of the new office building made it possible to better systematize the work of the Guam station during the year and the additional space enabled the installation of a very complete system of files and records and gave room for the growing reference library. The governor of the island ceded to the station for its use a tract of about 130 acres of land adjoining that purchased in 1910. Much of this land is rough and rolling and sparsely covered with native grasses. Very little is adapted to immediate cultivation, but most of the tract can be used for pasture. It represents a type of land of considerable extent on the island and any successful experiments carried out on this tract will be of wide application.

The field and garden work gave better results than that of previous years, due probably to the better condition of the soil as a result of continued cultivation. In the field crop work, principal attention was given to an experiment with corn. (Pl. III, fig. 2.) Varieties secured from tropical countries were compared with the kinds commonly grown on the island. Corn constitutes a staple food for the people of Guam, and as there are comparatively large areas adapted to its culture the extension of its cultivation is considered highly important. The station solved the forage plant problem by demonstrating that the sorghums, such as Kafir corn and similar crops, can be readily grown and the area devoted to experiments with forage plants of this type was therefore reduced.

Among the grasses introduced by the station Para grass (*Panicum molle*) has proved by far the best for planting, whether soiling system or feeding is followed. From 25 clumps of roots introduced in 1910, the station has now over an acre of this grass and several wagon loads of roots have been distributed to ranchers for planting. *Paspalum dilatatum* and Guinea grass (*Panicum maximum*) have both given satisfactory results and either would have been an important acquisition were it not for the fact that the Para grass has proved to be a better and more adaptable species. Other field crops, among them a number of species of leguminous plants for human food, forage, and the restoration of soil fertility, were given attention.

Vegetables, almost without exception, produced better yields and the product generally showed an improvement in quality. The experiments with vegetables included a large number of varieties sown at different times in the year to determine the most advantageous time for planting.

The work with tropical fruits was largely extended. The pineapples introduced from Hawaii have shown such pronounced superiority over native sorts that all available plants were distributed and 1,000 suckers ordered from Honolulu for further distribution among planters. Other introductions that have not yet fruited include oranges, lemons, pomelos, Japanese persimmons, peaches, bananas, sapotas, grapes, and other fruits. In addition, a number of palms, rubber trees, ornamental, and hedge plants have been introduced and are now growing on the station grounds. The avocado seedlings introduced from Hawaii produced fruit of high quality.

During the past fiscal year D. T. Fullaway, entomologist of the Hawaii Experiment Station, was detailed to Guam and made a preliminary survey of the insect fauna of the island, giving especial attention to the pests of economic plants. A large number of specimens were collected, the most of which have been identified and reported upon in the annual report of the Guam station.

The income of the station during the past fiscal year was as follows:

United States appropriation.....	\$15,000.00
Sales and other funds.....	59.74
Total.....	15,059.74

The work of the Guam station has created a general interest in agriculture on the island, and has largely increased the prospects of the native population by demonstrating the possibilities of growing abundant forage and other crops with the use of suitable varieties and modern methods of cultivation and soil treatment. The number of applications for seeds and plants continues to increase and indicates a growing interest in gardening. The continued cooperation and assistance of the local authorities promises well for the success and influence of the station.

HAWAII.

Hawaii Agricultural Experiment Station, Honolulu.

Under the supervision of A. C. True, Director, Office of Experiment Stations, United States Department of Agriculture.

E. V. WILCOX, Ph. D., *Special Agent in Charge.*

The Hawaii station continued its work during the past year largely with a view to diversifying the agriculture of the islands. In cooperation with the Territorial authorities and private individuals, demonstration farms were established on Maui and Oahu in addition

to those on the islands of Hawaii and Kauai, and all these farms are now in operation.

Since the station's establishment the pineapple industry has risen to second rank in importance of the industries of the Territory and the area devoted to pineapples has rapidly increased. In this expansion of the industry the station has taken an active part in determining some of the causes of failure of pineapples to grow in certain soils, particularly those containing large amounts of manganese. Investigations were conducted on the function and distribution of manganese in plants and soils, and the results were published during the year in bulletin form. Breeding experiments were undertaken to secure a strain of pineapples less subject to the effects of manganese and also, if possible, to obtain a more uniform strain of pineapples than those now planted in order to prevent waste in canning.

The experiments with cotton indicated conclusively that a good yield of excellent cotton may be produced on lowlands and in protected localities, but that exposed areas, particularly at elevations of 500 feet, should be avoided in planting the crop. On the whole, Caravonica cotton has given better satisfaction than Sea Island, and last year's crop was sold at the station at 18½ cents a pound and was reported equal to the best Rough Peruvian for use in mixing with wool. The methods of pruning worked out at the station and the use of lantern traps have demonstrated the possibility of controlling the cotton-boll worm, provided these means are systematically applied.

A study made of the pulp which accumulates as a result of decorticating sisal leaves showed it to contain high percentages of mineral plant food in readily available form, and its value as a fertilizer was clearly demonstrated.

Further tests of varieties of rice imported directly from Japan indicated that these rices, when grown in Hawaii, give a product equal to that imported from Japan in the milled form, and it is probable that the importation of milled Japan rice will not be necessary to the same extent that has been considered necessary in the past. Fertility experiments again showed conclusively that ammonium sulphate is the best form in which nitrogen can be applied to the rice crop and that nitrate of soda is quite unsuited to the purpose. It was further found that the fertilizer should be applied during the early growth of the rice plant rather than at the later stages of growth as is the oriental practice.

In cooperation with Territorial authorities the station devoted considerable time to the study of the habits and life history of mosquitoes and also to the problems connected with the Mediterranean fruit fly, which pest has made its appearance in Hawaii. Arrangements were made for the breeding and distribution of parasites of

this insect pest. In connection with quarantine work, the station conducted a method of clean culture for bananas by means of which scale infestation can be avoided.

The continued propagation work with mangoes and avocados showed that these fruit trees may be easily budded, grafted, or in-arched, and that the difficulties of this work are little more serious than those met with in connection with the deciduous orchard trees. The selection of strains of highly flavored papayas from trees bearing perfect flowers was continued.

Some attention was given to a latex-bearing tree (*Euphorbia loricifolia*) occurring abundantly in Kona, Hawaii. This tree produces an abundance of latex, the dried material of which contains nearly 60 per cent of a resin, apparently identical with chicle, and from 14 to 17 per cent of true rubber. Work was inaugurated to demonstrate the use of this latex in a commercial way.

A number of other investigations were in progress, among them a study of the kukui-nut oil, the means of transmission of Manson's eye worm in poultry, artificial methods of breeding in bees, and a general survey of the soils of Hawaii. The soil survey has been in progress for about four years and is nearing completion.

The work at the demonstration farms represented several distinct lines. On the island of Hawaii one of the stations gave special attention to dairying and forage crops, while the other near Hilo studied the culture of bananas and taro, the results thus far indicating that the yield and quality of taro may be greatly benefitted by proper systems of planting, cultivation, and fertilization. At the demonstration farm on Maui, the work was largely devoted to methods of tapping Ceara rubber trees, drying and curing rubber, and studying the chemical composition of rubber and the growth of intercrops between the trees. It is reported that through this work the quality of rubber obtained and the economy of its production have already been improved. The demonstration farm on Kauai gave special attention to growing pineapples, peaches, potatoes, onions, corn, and various leguminous plants, while at the farm on Oahu, experiments with broom corn, potatoes, pineapples, and leguminous and other crops were conducted under the conditions of dry-land farming.

The publications received from this station during the year were as follows: Bulletins 23, Leguminous Crops for Hawaii; 24, The Assimilation of Nitrogen by Rice; 25, The Avocado in Hawaii; 26, The Function and Distribution of Manganese in Plants and Soils; Press Bulletins 31, Brief Instructions for Farm Butter Makers; 32, Cultural Methods for Controlling the Cotton Bollworm; 33, A Study of Humus in Hawaiian Soils; 34, Cotton in Hawaii; and the Annual Report for 1911.

The revenues of the station for the fiscal year ended June 30, 1912, were as follows:

United States appropriation.....	\$30,000.00
Sales and other funds	13,749.40
Total.....	43,749.40

The work of the Hawaii station has met with promising success in the establishment and improvement of agricultural industries, and the recently organized system of demonstration farms or branch stations offers an opportunity for obtaining much information in an experimental way and of bringing the work of the station as a whole more directly to the attention of the people.

Hawaiian Sugar Planters' Experiment Station, Honolulu.

C. F. ECKART, M. S., *Director.*

The Hawaiian Sugar Planters' Station during the past year continued to increase the scope of its activities and to plan its work on a larger scale. At the substation at Waipio, field experiments of various kinds were inaugurated on a complete plantation scale in order to apply the results directly to general plantation conditions. A complete installation was made at one of the largest factories for carrying on experiments in connection with investigations on the Battelle process, which were pursued the past season in a preliminary way and which are to be continued.

The most important entomological work of the year consisted in rearing and distributing colonies of the cane-borer tachinid and in determining to what extent this parasite has become established on the plantations, all of which were supplied with one or more colonies. Investigations conducted on some of the plantations where the parasite was first established showed that a large percentage of the borer grubs was parasitized, in one instance an accurate count 50 per cent of the grubs found being affected. A new cane pest (*Anomala orientalis*), a Japanese species, was identified during the year and studies of the insect immediately begun brought out the fact that a bacterial disease attacking the grubs holds the pest in check. The introduction of horn-fly parasites did not meet with encouraging results, but efforts in this direction were not abandoned. Additions to the insect collections and the care and arrangement of the same occupied a considerable part of the time of the entomological staff.

The research work in cane pathology was conducted along the lines indicated in the previous report of the station and articles based on original work were published from time to time. The studies of the iliau fungus were completed and the results were published in bulletin form. Etiological studies of cane diseases, including yellow stripe disease, Fiji disease, and sereh were continued

and certain pathological phenomena common to all of them were noted. It was found that the yellow-stripe disease can cause serious losses if allowed to spread, but that the climatic conditions are not congenial to the development and spread of sereh. A study of the spot diseases of cane leaves brought to light many new and important facts concerning the habits and life histories of the parasites which cause them. Numerous fungi were cultivated and their parasitism was tested out by inoculation experiments. Three distinct strains of the eye-spot fungus (*Cercospora sacchari*) were isolated, one of which proved to be far more virulent than the others. A study was also made of six fungi parasitic on sugar-cane insects and the life cycle and parasitic habits of three of these, including two new species, were worked out. Other field and laboratory work included cultural studies of diseased tissue of alfalfa, alligator pear, banana, carnation, eucalyptus, geranium, mango, pepper, sweet potato, and taro, and microscopic examination for the purpose of diagnosis of diseases on cotton, date palm, orange, peach, pineapple, rose, and vanilla. The diseases of banana and eucalyptus, being considered of more than ordinary economic importance, received special attention.

The subjects studied under chemistry and sugar technology included the behavior of cane fiber under pressure, evaporation under multiple effect, molasses in its relation to nitrification transformation in the soil, the heat of combustion of bagasse from Hawaiian cane, mill control work in 26 different factories, and general analytical work embracing 2,045 analyses of fertilizers, soils, and miscellaneous substances.

The planting of 78 acres of cane for experimental purposes at the Waipio substation constituted an important feature of the agricultural work of the station during the year. The series of field experiments undertaken covered irrigation, fertilizer, cover crops, and variety and culture tests with sugar cane. In addition to this work an area was devoted to growing seed cane of the promising seedlings and other varieties for distribution. A long line of experimentation on the question of stripping was closed out at Honokaa. This test was applied to the Striped Tip cane, the nature of which indicated that it might require stripping. The results did not show any loss from the practice but the gains did not pay for the extra work required. The continued testing of seedling varieties showed that a number of the new canes under observation possessed distinct properties of early maturity and a number of them were found promising for short ratooning purposes. In another variety experiment it was found that a decided deterioration took place in several of the most promising canes between January and March, or when about 18 months old. Several hundred seedlings propagated in

1911 were examined this year and after discarding the worthless ones the remaining 37 were grown for further testing. Some work was also done on the use of crops for green manuring on sugar plantations. A large number of leguminous plants were tested but those giving the more reliable results were Brazilian velvet bean, Mauritius velvet bean, *Dolichos lablab*, White Jack bean, and Sann hemp.

The publications received from this station during the last two years were as follows: Division of Agriculture and Chemistry Bulletins 31, The Determination of Sucrose in Cane Molasses; 32, Bagasse Analysis—Determination of Sugar Moisture; 33, Sulphate Scale in Evaporators; 34, Some Biochemical Investigations of Hawaiian Soils, with Special Reference to Fertilizing with Molasses; 35, The Inversion of Cane Sugar under the Influence of Acids and Neutral Salts; 36, The Effect of High Temperatures on Cane Sugar in Solution; 37, Lysimeter Experiments; 38, The Milling of Cane Considered in Relation to the Volume Occupied by the Fiber; 39, The Influence of Molasses on Nitrification in Cane Soils; Division of Pathology and Physiology Bulletin 10, Diseases of the Pineapple; Division of Entomology Bulletins 9, On Some New Species of Leaf Hopper (*Perkinsiella*) on Sugar Cane; and 10, Parasites of Insects Attacking the Sugar Cane.

This station receives no direct aid from the Federal appropriations.

IDAHO.

Agricultural Experiment Station of the University of Idaho, Moscow.

Department of the University of Idaho.

W. L. CARLYLE, M. S., Director.

The most important change at the Idaho station during the past year was the reorganization of the dairy department, which was divided into two sections, the one dealing with dairy manufactures and the other with dairy production. A demonstration dry farm was established at Aberdeen on a tract of 80 acres of new land leased for 15 years and the work was planned on a cooperative basis with this department.

As in the previous year, the Adams fund work of the station was confined to seven projects. The work on different phases of the gluten content of wheat had a bearing mainly on the possible influence of soils and irrigation on the protein content. The studies of wheats from different localities were partly reported in Bulletin 72 of the station. The chemical staff gave a considerable portion of its time to this project.

The work on the duty of water in summer, winter, and fall irrigation was transferred to Gooding, where more uniform and more favorable soil conditions obtain. Plat work with different crops, such as

alfalfa, wheat, oats, barley, and potatoes, was carried on to determine the amount, method, and time of application of water, and comparisons were also made in tank experiments. Evaporation data were collected and soil samples were taken at regular intervals to determine possible changes in the plants due to the methods of irrigation.

Progress on the apple-breeding project included the making of about 1,700 cross-pollinations in 1912, of which about 20 per cent were successful. Seedlings from fruits secured in 1911 were grown in the greenhouse. Direct and reciprocal crosses of different varieties were studied, together with the characters of seedling and parent trees in an attempt to standardize the descriptions of the varieties used in the experiments. A large number of experimental trees were grown in nurseries and scions were top-worked into older trees to hasten fruiting.

The work on keeping quality and flavor of butter as affected by the degree of acidity of cream and by the amount of salt used was continued, inclusive of bacteriological investigations. Butter made from sweet, sour, and pasteurized cream was stored and examined from time to time and in addition, chemical analyses were made of the butter at monthly intervals. In the study of fat-splitting organisms, 10 species were isolated and an effort was made to determine the specific action of each. Bacteriological examinations were also made to determine the progress of rancidity in butter and the effect of aerobic and anaerobic conditions, temperature, pressure, sunlight, and other factors on the keeping quality of butter was investigated.

The bacteriological soil studies in progress had a bearing mainly on nitrification under different conditions. Studies were pursued to determine the optimum and maximum soil moisture content for the nitrifying process.

The project on the relation of calcium and magnesium in the growth of wheat was continued in the analysis of samples for the study of the phosphorus and ash content. In connection with the irrigation investigations, a considerable amount of data has been collected and is available for future use.

Most of the departments of the station also had considerable work in hand under Hatch and other funds. Plant disease studies were carried on with special reference to an apple disease locally known as rosette, and proving quite destructive in parts of the State. Since the close of the fiscal year this work has been submitted and approved as an Adams fund investigation.

The dairy department in addition to its Adams fund work carried on experiments in the storage of butter and with limewater as affecting the acidity of the product. Scoring tests and analyses were made of samples of ranch and creamery butter, experiments were conducted with pure cultures in butter production, and observations were made on the shrinkage of butter and the changes in butter fat.

The horticulturist completed a 4-year study of tomato and onion culture, together with experiments on summer and winter pruning, and prepared the results for publication. Steps were taken to enter upon pomological investigations, and work was continued on the cultivation of vegetables and strawberries, including tests of varieties.

The work in agronomy consisted largely of rotation experiments with all the principal crops grown in Idaho, winter barley, oats, and wheat receiving particular attention. Tests were further made of peas, soy beans, alfalfa, and other similar crops. A series of increase plats was established for the propagation of promising varieties. Experiments in corn improvement were in progress, the variety Minnesota No. 13 being used for comparison and the object of the work being largely the production of corn for silage. In addition, selection work with potatoes and experiments on grain smut eradication were carried on. A new series of rotation plats was laid out to secure improved experimental conditions.

The animal husbandry work of the station consisted of lamb-feeding tests, experiments with pigs in which cereals were supplemented with soy-bean meal, tankage, and other feeding stuffs, and of experiments to test the value of alfalfa in southern Idaho, particularly the utilization of alfalfa hay in feeding dairy cows. The work with alfalfa was conducted in cooperation with this department and with local stock raisers.

The substation work during the past year was in satisfactory condition. At Gooding, the studies included experiments in irrigation, soil moisture, and evaporation. At Caldwell, an attempt was made to develop improved methods of farming. The irrigation work at this place was abandoned on account of unfavorable soil conditions. At Clagstone, a tract of 200 acres of cut-over timberland has been deeded to the station, upon which clearing operations were begun. A bulletin on clearing and preparing these lands for cultivation was in preparation.

The publications received from this station during the year were as follows: Bulletins 70, Strawberry Culture in Idaho; 71, Weed Pests of Idaho and Methods of Eradication; and 72, A Report on the Milling Properties of Idaho Wheat.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products, including balance from previous year.....	8,524.44
Total.....	38,524.44

The Idaho station is developing along definite lines, its active interest in the agricultural affairs of the State is steadily increasing, and State support is more definitely assured than heretofore.

ILLINOIS.**Agricultural Experiment Station of the University of Illinois, Urbana.**

Department of the University of Illinois.

EUGENE DAVENPORT, M. Agr., LL. D., *Director.*

At the Illinois station there was a general growth of work fostered by the resources available, and improvements were made by which the station will be materially benefited. There were under process of erection about \$180,000 worth of new buildings for agriculture, the most important of which from the standpoint of the station is the \$50,000 glass house, although it will have more or less use of all the buildings.

The Adams fund was divided between the departments of thremmatology, animal husbandry, and horticulture, and good progress was made in most lines of work, although in some instances changes in personnel interfered with the pursuit of investigations. The project on the effects of inbreeding in pigs again suffered from an attack of hog cholera, causing the death of about 50 animals, and was further retarded by a change in leadership. An effort was made to reorganize the work and to carry the investigation to a close.

A large amount of data accumulated in the work on the digestion and utilization of feeds in maintenance, growth, and fattening. This investigation involved digestion and metabolism experiments with different kinds of animals, together with an analytical study of different parts of the carcass. The work of reducing the data to final results and of summarizing and preparing the same for publication was pursued during the year.

The study of the transmission of characters in apples, sweet peas, and strawberries was carried on as planned. A large number of apple trees, some being now 5 years old, entered into the work which was followed at the station and at Olney. The construction of a plant-breeding house was undertaken largely for the benefit of this investigation. The work has heretofore included bud selection, the use of seedlings from select trees, and the crossing of standard with special varieties. Relatively good success in pollination was attained during the year, and the seedlings provided for the experiments now number 1,150. The work with sweet peas was actively pursued and the data on hand were prepared for publication. With strawberries the work was carried to the third selection and a study was made of the plant characters.

The statistical studies in heredity, which have resulted in a large accumulation of data, were carried on with corn along the lines of ear selection with reference to physical characters of variability as affected by soil fertility, and of observations on about 140 varieties bred for protein and oil.

Numerous and extensive lines of work were also conducted with Hatch and other funds, and the results of several of these activities were published during the year. In animal husbandry, feeding experiments with swine having special reference to maintenance requirements were continued, together with work on the protein, fat, and carbohydrate requirements for fattening and breeding. Feeding tests with farm work horses were continued, and a bulletin on the experiments showing the comparative value of timothy and clover hay, of various grains and by-products, and of different methods of feeding was published early in the year. A study on the relative economy, composition, and nutritive value of the various cuts of beef was completed, and the results covering slaughter tests and a comparison of the nutritive value of the wholesale and retail cuts of meat were published in Bulletin 158 of the station.

The department of dairy husbandry had in progress a systematic study of pasture problems, giving attention principally to cultural and manurial treatment, grazing capacity, and nutritive value of herbage. The relative value of well-balanced and unbalanced rations for dairy cows was determined in a series of feeding tests, and methods of sampling cream for testing were compared. In addition, cytological and bacteriological studies of milk were made and the accuracy of certain methods was investigated. The extension work of conducting official records of pure-bred dairy cows was continued and the results were published in bulletin form.

In the department of botany and bacteriology, studies were made the past year on the tuberculosis bacillus with a bearing mainly on the duration of its life under natural conditions, and investigations were followed on plant diseases, including a radish disease, sweet-potato diseases, the mold of corn, cabbage wilt, and other maladies.

The department of agronomy pursued the soil survey work as heretofore, using in that connection the experimental farms in different localities, and publishing the results under State funds. One feature of this work was a study of peaty swamp lands and of soils containing an excess of magnesium carbonate for the purpose of determining means of rendering them productive. The breeding work with corn and other field crops made good progress, and it is believed that the results of the station's work on soils and crops are beginning to appear definitely in increased yields per acre of corn and wheat in the State.

Among other work in olericulture cooperative experiments with muskmelons, comprising the use of manure and commercial fertilizers and the manner of application, were continued during the year, and the results were summarized in a bulletin. It was observed that there may be wide differences in the relative effects of different fertilizer treatments for muskmelons in different seasons.

The entomological department gave particular attention to insects injurious to stored grains and their ground products, and to a number

of important insects of Illinois shade trees and shrubs, and also investigated the dying of elms in the southern part of the State. Bulletins were either prepared or published during the year on these different lines of work.

Demonstrations were established on various farms donated to the State for the purpose by individuals or by communities. These donations now number 19, aggregating something over 400 acres of land ranging in quantity from 15 to 30 acres each.

The publications received from this station during the year were as follows: Bulletins 150, Feeding Farm Work Horses; 151, Some Important Insects of Illinois Shade Trees and Shrubs; 152, Contagious Abortion of Cows; 153, Comparison of Methods of Sampling Cream for Testing; 154, What is the Matter with the Elms in Illinois; Circulars 150, Collecting and Testing Soil Samples; 151, Four Systems of Dairy Farming and the Profit on Each; 152, Feeding Dairy Cows; 153, Additional Facts in Swine Feeding, with Special Reference to Developing Swine for Breeding Purposes; 154, The Home Vegetable Garden; 155, Plant Food in Relation to Soil Fertility; 156, Rice Blight; 157, Soil Fertility—Illinois Conditions, Needs, and Future Prospects; 158, Tuberculosis—A Plain Statement of Facts Regarding the Disease, Prepared Especially for Farmers and Others Interested in Live Stock; Soil Reports 1, Clay County Soils; 2, Moultrie County Soils; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$14,950.80
United States appropriation, Adams Act.....	14,987.24
Balance from United States appropriation, Hatch fund.....	49.20
Balance from United States appropriation, Adams fund.....	12.76
State appropriation, including balance from previous year....	171,482.84
Farm products, including balance from previous year.....	34,557.49
<hr/>	
Total.....	236,040.33

The Illinois station with its relatively large resources is doing a very considerable amount of scientific and practical work. It is wisely strengthening its staff by endeavoring to retain the staff members and giving them opportunities for further study. The station, with other departments of the University, has been hampered in its work by rulings by State authorities regarding the purchase of supplies and the printing of publications.

INDIANA.

Agricultural Experiment Station of Indiana, Lafayette.

Department of Purdue University.

ARTHUR GOSS, M. S., A. C., *Director.*

The Indiana station continued its various lines of activity during the year with satisfactory progress. A number of changes occurred on the staff but without extended interruptions to the work. On

November 12, 1911, a storm did much damage to several buildings, the greatest loss being in the destruction of the station seed house and the experimental sheep sheds. Some farm machinery was destroyed and considerable quantities of seed of improved strains were lost. The total loss was estimated at \$20,000. The construction of a substantial brick building to replace the seed house was begun during the year. A building was also erected at a cost of \$12,000 for use in connection with the serum-production work. A dairy building to cost \$50,000, mainly for the use of the college, was in course of construction. Progress was also recorded in reorganization, the extension work previously under the station being organized as a separate extension division, coordinate with the station and the school of agriculture.

The Adams fund was divided among the botanical, veterinary, and dairy departments. The study of the rusts was continued as in previous years. In the hog-cholera investigations the study on the production of hyperimmune hogs by means of virulent normal salt solution was completed. The value and limitations of the method were largely determined, and work was done further on the use of virulent normal salt solution in mixtures with other virulent material for the purpose of hyperimmunization. By means of temperature and other data obtained by injections into young pigs, the relative virulence of a number of different materials was studied, and other lines of investigation bearing on the subject were followed.

Two bulletins dealing with the results of the studies on the moisture content of butter were completed and published during the year. These point out that factors not under control in butter making affect the moisture content of butter as they affect its mechanical texture, which is governed by the chemical composition of the butter fat and the size of the fat globules. It was determined that the chemical composition of butter fat is largely controlled by breed, period of lactation, and feed, while the size of the fat globules is controlled largely by breed, period of lactation, changes of feed, and other factors affecting the physical condition of the animal. The combination of factors through which moisture control in butter is rapidly effected was found to be regulation of the churning temperature, adjustment of the amount of water present during the working process according to the firmness of the butter, and the systematic use of a reliable moisture test.

Work on the pasteurization of gathered cream in relation to bacterial flora and keeping quality of butter was actively pursued. As heretofore, account was taken of the effect of length and conditions of storage on butter produced from pasteurized and unpasteurized cream. The stored butter was scored every three months, when samples were taken for bacteriological and chemical examination.

Many lines of important work were supported by Hatch and other funds. One of the principal activities of the veterinary department was the production with State funds of antihog-cholera serum, which increased considerably over the previous year, when serum to the amount of \$16,000 was sold in accordance with State regulations. This work was materially aided by the greater and better facilities afforded by the new building erected for the purpose.

The animal husbandry department continued feeding experiments with cattle and hogs and published the results of some of its work. The cattle-feeding experiments included the comparison of corn silage and clover hay as roughage and the study of the influence of different proportions of cottonseed meal in rations for fattening steers, together with observations on the relative merits of long and short feeding periods in fattening. With swine, experiments to determine the value of ground corn were continued with pigs of different ages and weights. The experiments with hominy feed for fattening hogs, which included comparisons of hominy feed and shorts with corn meal and shorts, and hominy feed and tankage with corn meal and tankage, were completed and the results made public. As compared with corn meal the hominy feed produced gains more rapidly and on less grain.

In feeding experiments with lambs, timothy and clover hay were compared and the value of silage and cottonseed meal in rations for lambs was studied. Poultry work in this department included experiments on rations for laying hens, attention being given to the value of skim milk, meat scrap, fish scrap, and green feeding stuffs, such as sprouted oats, silage, steamed clover, and cabbage for use in winter. Experiments were also made with incubators and on fattening cockerels for market and the influence of range on egg production. Progress was made in the establishment of a pedigreed flock for experimental work. Among other work of the dairy department, experiments were made to determine the best management of the herd in changing from dry feed to pasture.

The horticulturist continued the orchard management experiments at Laurel with reference to the influence of clean tillage, cover crops, sod mulch, and other methods of treatment on growth, earliness of bearing, yield, color, and keeping quality of fruit, and on the temperature and humus and moisture content of the soil. Variety tests were made with strawberries, potatoes, tomatoes, and other fruit and vegetable crops. Experiments in orchard heating, including the test of various kinds of heaters, were completed and the results published in Bulletin 154. At seven places demonstration orchards were maintained to determine the cost of crop production and of spraying and to demonstrate the care of home orchards.

The work in agronomy covered a wide range and included numerous projects. Soil improvement work was done on different types of soil

in five fields in different parts of the State. Two new fields were added during the year. On the one, a tile-drained field in southeastern Indiana, a three-year rotation was begun with experiments on the effect of lime, and on the other field, which has a white, thin, clayey, upland soil and includes 10 acres of drained land, three and four course rotations with wheat, clover, corn, and soy beans were inaugurated. On one of the older demonstration farms having a black peaty soil, high in nitrogen, studies were made of nitrate formation and of the use of fertilizers and lime. The results of outlying experiments in rendering black soils of swamp origin productive were reported in Bulletin 157. Cooperative work in the improvement of the oat crop included tests of fertilizers and cultural methods.

Fertilizer tests were also conducted with tomatoes grown as a field crop, while with potatoes similar tests were made on different types of soil, including peat, loam, and clay. Studies were further carried on with potatoes in a series of pot experiments to determine the effect of different factors on the composition and quality of the tubers. Breeding and selection experiments were conducted with wheat, oats, barley, corn, soy beans, and clover. In work with corn, particular attention was given to a study of smooth and rough dented seed corn. The cooperative corn-breeding work was continued, but was reduced in amount. Cooperative experiments with this department included tests of seed oats from South Dakota, Kansas, and Indiana, experiments with oat hybrids of 1909, clover seed production, including methods of pollination by bumblebees and mechanical means, and the time of cutting clover as related to seed production from second growth.

The publications issued by this station during the year were as follows: Bulletins 150, Why Do Cream Tests Vary—Factors Affecting Richness of Cream—Relation of Butter Fat to Butter; 151, Commercial Fertilizers; 152, Commercial Feeding Stuffs; 153, Winter Steer Feeding, 1909-10 and 1910-11; 154, Orchard Heating (with popular edition); 155, Results of Cooperative Fertilizer Tests on Clay and Loam Soils; 156, Commercial Fertilizers; 157, Unproductive Black Soils; Circulars 28, What Purdue is Doing for Indiana Agriculture; 29, Live Stock Judging for Beginners; 30, Commercial Apple Growing; 31, Small Seed Improvement; 32, Canada Thistle and Its Eradication; 33, Liming the Soil; 34, Orchard Spray Calendar; 35, Supplementary Pasture Crops; 36, How to Grow Alfalfa; 37, Housing Farm Poultry; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Miscellaneous, including balance from previous year.....	82,654.36
 Total.....	 112,654.36

The Indiana station has in progress a relatively large amount of scientific and practical work, and it enjoys the support and confidence of the farmers of the State in a large measure.

IOWA.

Iowa Agricultural Experiment Station, Ames.

Department of Iowa State College of Agriculture and Mechanic Arts.

C. F. CURTISS, M. S. A., D. Sc., *Director.*

Several important changes were made in the staff of the Iowa station during the year. W. J. Kennedy was made head of the extension department to succeed P. G. Holden, resigned, and was himself succeeded as head of the animal-husbandry department by W. H. Pew. W. A. Lippincott, in charge of the poultry section, went to the Kansas station and was succeeded after the close of the fiscal year by G. M. Turpin, of the Utah station. J. Buchanan, of the Ontario Agricultural College, was placed in charge of the cooperative experiments with farm crops. A number of vacancies in minor positions were also filled during the year. R. A. Pearson, formerly commissioner of agriculture of New York, was appointed president of the college, to enter upon his duties after the close of the year.

Important additions were made to equipment in the various departments of the station, among these a new veterinary building (Pl. IV), which was partly completed and occupied during the year, estimated to cost, with equipment, about \$250,000.

No new lines of Adams-fund work were undertaken during the year, but the five research projects in hand were continued. The study of Mendel's law in cattle breeding has involved to date the study of about 100 animals with regard to color and horn characters, and data with reference to the Mendelian relationship of these characters have been collected and compiled.

In the study of the effect of better feed, environment, and breeding in improving mongrel dairy cows, digestion experiments were included to determine the relative efficiency of feeds consumed by the improved and unimproved cows. This work has shown the possibility of greatly improving the productive capacity by good care and feeding or by the addition of improved blood.

In the apple-breeding project work was concentrated especially on hardiness against drought and low temperatures as a unit character. Of several thousand trees entering into the investigation, about 75 cross-bred trees set fruit during the year. The chemist cooperated by studying the sugar and acid content of the apples.

The investigations on the relation of humus to the physiological activities of the apple were continued in the rented orchard, the lease of which was extended to 10 years. Some difficulty in the form of

canker infection was encountered, but in other respects work progressed satisfactorily. Controlled experimental conditions were established in the orchard, and the different treatments began to show definite results.

The study of the organic matter of the soil dealt almost exclusively with the nitrogenous compounds of the soil and the changes they undergo under different methods of soil treatment.

The work with Hatch and other funds was, as in previous years, varied and extensive. Investigations in soil bacteriology, pursued quite actively, included studies of the bacteriological effects of liming, the bacterial activities of frozen soils, and of the factors governing the numbers and distribution of organisms in some typical Iowa soils.

The chemical department made studies of the influence of mineral matter in brood-sow rations and of pasteurization on the composition of butter, together with investigations of the chemical changes which occur in the silage-making process and of the chemistry of lime-sulphur and lead-arsenate mixtures. A research bulletin on volatile aliphatic acids of corn silage was published during the year.

The animal husbandry work included experiments in wintering breeding sows and ewes, hogging down corn, dry-lot fattening of 2-year-old cattle, finishing steers on silage, forage crops for hogs, fattening range lambs, milk production in sheep, and comparison of beef and dairy types for meat production. In dairy husbandry, studies were made of causes of variations in fat production, succulent feeds for milk production, milk substitutes for calves, and correlation between form and function in cows. The poultry work, interrupted to some extent by changes in staff, included a continuation of experiments in breeding for egg production, brooding in large groups, fattening and finishing for market, producing capons, and of the study of the causes of weakness in brooder chicks. In cooperation with the rural engineering department, the essentials of a good poultry house for Iowa, together with complete working plans for three houses embodying these essentials, were set forth in a bulletin.

In horticulture, experiments were continued on potato growing, spraying fruits, cold storage of apples, orchard heating, and studies on apple-crown gall.

A large amount of work, mostly in continuation of previous investigations, was carried on in the department of agronomy, including more particularly the extensive series of experiments on crop rotations and soil management at the station and in southern Iowa; drainage experiments, tillage, and fertilizer experiments, breeding, variety, and culture tests of cereals and forage crops, and a plant food survey of Iowa soils. Cooperative crop experiments with some 280 farmers were carried on.

The work in dairying included observations and experiments on pasteurization of cream for butter making, shrinkage in butter, ice-cream making, causes of slimy starters, influence of chloroform on bacteria, *Bacillus bulgaricus* and its behavior in milk, and creamery construction.

In addition to the cooperative work with other departments already mentioned, the agricultural engineering department made investigations on the Iowa cycle engine, construction of water tanks, corrosion of fence wire, construction of hog houses, silos and other farm structures, and standardization and classification of farm machines.

In entomology, work was done on the oyster-shell scale, box-elder aphid, and potato insects, and on spraying for the codling moth and strawberry slug. Studies of the pear slug, in progress for three years, were completed and a bulletin on the subject was published. The life history of the insect and the time of its appearance and of its generations were worked out, and various sprays for its control were tested. The botanist studied the pollination of clover, eradication of quack grass, germination of weed seeds, onion smut, and fungus diseases of the apple.

Some studies and experiments were also made in forestry and in the nature and control of animal diseases.

The publications received from this station during the year were as follows: Bulletins 125, Trussing and Boning Chicken for Fancy Trade; 126, Planning and Adorning the Farmstead; 127, Spraying Practice for Orchard and Garden; 128, Some Data for Oat Growers; 129, Orchard Heating; 130, The Pear Slug; 131, Four New Fungus Diseases in Iowa; Research Bulletins 1, The Chemical Nature of the Organic Nitrogen in the Soil; 2, Some Bacteriological Effects of Liming; and 3, The Chemical Nature of the Organic Nitrogen in the Soil.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	55,000.00
Farm products.....	12,326.44
Miscellaneous.....	944.64
Balance from previous year.....	13,253.36
 Total.....	 111,524.44

The work of the Iowa station has been much strengthened and its progress facilitated by a definition of function which leaves certain workers free to give their entire time to station and research work. The fact that the inquiry for bulletins the past year was 60 per cent greater than in any former annual period, and that the permanent mailing list was increased about 30 per cent, is an indication of the extent to which the station is reaching the agricultural people of the State.

KANSAS.

Kansas Agricultural Experiment Station, Manhattan.

Department of Kansas State Agricultural College.

E. H. WEBSTER, *Director.*

Few changes were made during the year at the Kansas Experiment Station in the character of the work and the personnel of the station staff. Since the close of the year E. H. Webster was succeeded by W. M. Jardine as director. The west wing of the new agricultural building, which will house the departments of agronomy, animal husbandry, poultry husbandry, milling industry, and the live-stock registry board, together with furnishing temporary office quarters for the director of the station, was about completed.

Progress was made in the Adams fund work of the station and definite results were recorded. In the stored grain and mill insect investigation a bulletin was submitted for publication. In connection with life-history studies, it was found that mill insects, more particularly the Mediterranean and other flour moths, can not withstand a temperature of 122° F., and that mills may be cleared of these insects by raising the temperature in the building to that point.

For the environmental study of Hessian fly and plant lice injurious to certain field crops, special apparatus was brought together for controlling temperature and humidity in studying the effect of changed conditions on the insects at different stages of their life cycle. The data relating to certain species were prepared for publication. The investigations on the "green bug" were closed out and a report on the work will be made.

The project on the influence of nutrition upon growing animals was conducted quite actively. With pigs the attempt was made to find out the effects of feeding corn alone, and to determine what it is that the corn fails to supply. A study of the synthesis of animal and vegetable proteins included analyses of pigs at the beginning and at the end of the feeding period to ascertain what changes had taken place. The effects on nutrition, growth, and conformation of changing from a ration of corn alone to a standard ration and then back again to corn alone was also investigated. Considerable work along related lines was done with steers. Digestion experiments were made with these animals to see how they utilize the feed, and some histological work was conducted. With sheep the effect of prenatal development on lambing, size of lambs, and other similar factors was studied.

In the wheat-breeding project the work was centered especially on hybridization and selection of segregates. A study of 15 to 20 families of hybrids of which many are promising was continued. In the alfalfa breeding investigations straight selection work was

carried on, partly in the effort to secure greater drought resistance and larger yielding capacity. This work has furnished a considerable quantity of material and some of the selections are ready for distribution.

The investigations on the decomposition of eggs had a special bearing on the influence affecting the bacterial flora of eggs. The age of the fowl, feeding different rations, the use of the male, the storage of eggs, and other factors in their relation to the bacteriological content were studied. Stored eggs showing decomposition were analyzed bacteriologically, and those giving no evidence in that direction were examined for condition. A special study was made of feeding alfalfa to determine its relation to the green discoloration of eggs with negative results.

The work on cerebritis in horses included experiments in feeding moldy corn to determine the relation of such feed to the disease and to find out whether the malady is the result of a toxin or an infection. An extensive study was made of the brain, particularly the blood vessels; and some work was also done on the effect of feeding moldy corn to cows.

With Hatch and other funds the entomologist continued work on the Hessian fly, mainly with a view to establishing dates of sowing wheat to avoid infestation. Life-history studies on the corn-ear worm were actively pursued and much attention was given to methods of control, including the application of a dust spray. Cooperative work was done with farmers in burning the bunch grass in pastures and meadows and along the roadsides for the control of the chinch bug. Some work on a cooperative plan was also done on fruit insects, especially codling moth and curculio, and some spraying demonstrations were made without expense to the station.

The zoologist conducted breeding work with grasshoppers to ascertain the laws of inheritance and the effect of extremes in environment, and subjected specimens of these insects to Mendelian analysis. Other work in this department included crossing the Caracul sheep on Lincolns, Merinos, and Shropshires; a study of the results in crossing Indian bulls on domestic cattle to obtain immunity to Texas fever; and an experiment with chickens fed different kinds of insects to observe the effect on tapeworms.

In connection with breeding drought-resistant corn, considerable work was done on transpiration, the osmotic behavior of root hairs, and on histological problems. A large number of hybrids in their second generation were studied and work was in progress on inheritance of size factors and of resistance to corn smut. An investigation of cereal diseases was carried on in cooperation with this department.

The horticulturist conducted spraying work and studied the influence of pruning, cultivation, fertilization, and other practices on the formation of fruit buds. Fertilizer experiments were made with

potatoes and experiments in progress with grapes included some plant-breeding work.

A large number of various lines of work were pursued in agronomy. Studies in soil fertility and seed-bed preparation were continued, and hybridization and selection work were conducted in a nursery comprising about 8 acres. The development and fixation of strains of wheat was followed as in previous years, and a number of such strains are about ready for distribution. With corn crossing and other breeding work was done and tests were made on methods of planting and different cultural practices. The soil fertility work was conducted on 120 one-tenth acre plats divided into 10 series with three and six year rotations, the use of various fertilizers, green manuring, and other methods of soil management. The work on seed-bed preparation was extended to oats and corn and special attention was given to nitrate development and the distribution of water in the soil. Sorghum and corn were compared as sources of silage and cultural tests were made with broom corn. The agronomist cooperated in soil bacteriological work on the effect of different crops and rotations on ammonification, and under State appropriations carried on cooperative work with this department in making a soil survey, and the farmers in farm demonstrations to answer local questions. The station also cooperated with this office in irrigation investigations at Garden City. (Pl. V, fig. 1.)

In conjunction with the dairy commission, work was done on cream grading, especially with reference to age of cream as affecting bacteriological content, the biological differences between first and second grade cream and yeasty cream.

The chemical department studied chemical changes in bread making, baking qualities of flour, and other topics relating to the milling and baking industries. A study was further made of all the amino acids which could be produced as well as of peptones, bran extract, germinated wheat, and other products. The acidity of flour and means of its determination and its relation to phosphates was also considered.

The publications received from this station during the year were as follows: Bulletins 175, Grasses; 176, How to Grow Wheat in Kansas; 177, Milling Tests of Wheat and Baking Tests of Flour; 178, Effect of Common Mill Fumigants on the Baking Qualities of Wheat Flour; 179, Kansas State Live Stock Registry Board Report No. 2; 180, Bacteriological Studies on Eggs; 181, The Permit System of Cream Buying; Circulars 18, The Kansas Feeding Stuffs Law Revision of 1911; 19, Burn the Chinch Bug in Winter Quarters; 20, The Hardy Catalpa; 21, Better Butter for Kansas; 22, The Condition of Kansas Seed Corn; 23, The Stallion Law and the Farmer; 24, Better Butter for Kansas; and Feeding Stuffs Bulletins 17-22, Registered Feeding Stuffs.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriations, including those for substations.....	61,500.00
Miscellaneous, including balance from previous year.....	1,778.36
Total.....	93,278.36

The Kansas station has a large amount of work in progress, which it is relating for the most part to the problems of agriculture in the State. It has shared in the prosperity of the college, and its force and equipment are being steadily strengthened.

KENTUCKY.

Kentucky Agricultural Experiment Station, Lexington.

Department of the State University.

J. H. KASTLE, Ph. D., *Director.*

Changes of great importance have recently occurred at the Kentucky station. M. A. Scovell, director of the station since its organization, died August 15, 1912. A. M. Peter, chief chemist, served as acting director until the appointment of J. H. Kastle, research chemist, as director of the station and dean of the college of agriculture. Numerous changes and additions of assistants and inspectors were made during the past year, partly as a result of increased appropriations from the State for investigation and extension work.

The last legislature made a permanent appropriation of \$50,000 per year to the station for experimental work on soils, horticulture, breeding and feeding of live stock, dairying, and poultry husbandry, and for extension work and the preparation of hog-cholera serum. Of the funds available during the year a large part was devoted to the hog-cholera serum work for which a laboratory has been established. An extension division was organized and a small poultry plant begun. An addition to the station building to cost \$50,000 was nearly completed during the year. This addition will more than double the capacity of the building, and will accommodate the chemical laboratories and the bacteriological, food, and feeding-stuffs work. A \$10,000 building for experiments with small animals was completed during the year.

Of the Adams-fund projects, work was especially active during the year on milk fever and infectious abortion. From the result obtained, milk fever appears to be due to the presence in the udder of a toxin similar to that producing eclampsia. Studies were made of the effect of injection of different substances in the udder, and successful trials of similar treatment for eclampsia were reported. The Bang bacillus was isolated and identified as a cause of abortion in cows, but the trouble is apparently due to a different organism in the case of mares,

and work on the isolation and identification of this organism was undertaken. It was shown that agglutination and complement fixation may furnish a means of diagnosing infectious abortion. Studies of various phases of the relation of calcium to the onset of labor were made during the year and reported upon. Only preliminary work was done on white scours in calves.

The study of enzymes of sugar-producing plants was confined to collecting evidence of the action of oxidases in various plants. A large amount of data was collected on the occurrence and distribution of nitrates in the tobacco plant.

Work was also very actively pursued during the year on the interrelations of the nodule bacteria on the different leguminous plants, special study being made of the transference of the nodule organism from garden pea to bean.

The life-history studies of the corn-ear worm and its enemies were continued and a report on the work was prepared. The effectiveness of the insects attacking the corn-ear worm was determined. As related to the work on the corn-ear worm, a study was made of the different molds of corn, and in this connection some very striking color-producing molds were isolated, one of them new to science. The purpose of this work was to show the relation of the corn-ear worm to mold and pellagra.

No work was done on the production of starch outside of the cell nor on the digestibility of the proteids of milk. The study of the bacterial disease of growing tobacco was held in abeyance, there being no appearance of the disease in recent years.

A microscope attachment, comparison ocular, designed by the bacteriologist of the station for examining normal and pathological tissue side by side in the same field is shown in Plate V, figure 2.

With Hatch and other funds, the chemist examined limestones and miscellaneous materials, conducted pot experiments on the availability of potash and the fertilizer requirements of soils, and tested official methods for lime-sulphur solution and soil and water analyses. In cooperation with the State geological survey, different soil types of the State were studied and described as to their location and area and their physical and chemical characters determined by mechanical and chemical analyses of typical samples. Based on this information, methods of improving these soils were suggested.

Extensive studies were made by the botanist and entomologist of insects injurious to stock and man, especially those prevailing in localities where pellagra occurs. Different kinds of insecticides for tobacco insects were tested. Work was also done on the condition of corn in its possible relation to pellagra in the localities where the disease occurs. Observations on the different species of catalpas found in Kentucky were made with reference to their culture, rate

of growth, value and uses, and insect enemies. The relation of the catalpa to allied species was also considered.

The department of animal husbandry in cooperation with this department conducted an experiment to determine whether or not it is necessary to use sulphur in tobacco dips for sheep scab. It was shown that the addition of sulphur to nicotin solutions of the prescribed strength did not enhance the curative value of the dips. A report on results of this work was made during the year.

The work in agronomy was enlarged during the period covered by this report. Sixty-eight half-acre plats were used on the station farm and the establishment of local experiment farms in different parts of the State was begun. Tests of forage plants and selection and breeding experiments with wheat, timothy, clover, and corn were continued. Experiments on rates of seeding and variety tests of wheat, variety tests of winter oats, and winter and spring barley were carried on, as well as on preparing land and liming alfalfa, and on sweet clover. Work with soy beans included a comparison with cowpeas for hay production, tests of varieties to determine their value for seed and for forage, and experiments in thickness and rate of seeding. Subsoiling with dynamite for corn was tested and the comparison was made of different rates and methods of planting corn to ascertain the influence of rate of planting and of drilling and growing the crop in checks. Cultivation experiments were conducted to find out when the last cultivation should be given. Seeds were tested for purity and germination as in previous years. Experiments on the growing and fattening of hogs on the various rotations of forage plants were continued.

Other lines of work included the enforcement of the fertilizer, food and drugs, and feed laws of the State, the preparation and distribution of hog-cholera serum, and experiments on immunizing suckling pigs. Studies of the normal chemical urinalysis of the dairy cow and of methods of sanitary analysis of water were completed during the year. Attention was further given to asymmetric color resemblance in the guinea pig, composition of the ash of the sap, leaves, and young stems of the wild grapes, the suprarenals of birds, and the translocation of mineral matters in plants grown first in soil and then in distilled water, and publications on various features of this work were issued.

The publications received from this station during the year were as follows: Bulletins 152, Commercial Fertilizers; 154, Blowing Stumps with Dynamite; 155, Wheat—Variety Tests, Cultural Directions, and Treatment of Diseases; 156, Concentrated Commercial Feeding Stuffs; 157, The Dipping of Sheep for Scabies in Tobacco Dips With and Without the Addition of Flowers of Sulphur; 159, A Preliminary Study of Kentucky Localities in Which Pellagra is

Prevalent; 160, Parturient Paresis (Milk Fever) and Eclampsia; 161, Soy Beans; 163, Corn Production; 164, The Catalpas and Their Allies; 165, Investigations of the Etiology of Infectious Abortion of Cows and Mares; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation, including balance from previous year..	41,961.33
Fees, including balance from previous year.....	82,863.83
Farm products, including balance from previous year.....	11,693.44
Miscellaneous, including balance from previous year.....	8,846.73
 Total.....	 175,365.33

The Kentucky station, as the result of liberal financial support on the part of the State and a stronger organization for research and extension work, has entered upon an era of expansion and progress and is giving greater attention to several highly important problems the solution of which will have a general application in agricultural science and practice.

LOUISIANA.

- No. 1. Sugar Experiment Station, *Audubon Park, New Orleans.*
- No. 2. State Experiment Station, *Baton Rouge.*
- No. 3. North Louisiana Experiment Station, *Calhoun.*
- No. 4. Rice Experiment Station, *Crowley.*

Department of Louisiana State University and Agricultural and Mechanical College.

W. R. DODSON, A. B., B. S., *Director, Baton Rouge.*

Comparatively few changes were made in the organization or personnel at the Louisiana stations during the past year. E. S. Tucker was appointed associate entomologist, and investigations on insects affecting stored rice were begun by him January 1, 1912. A seed-testing laboratory was established at Baton Rouge by this department, with J. M. Moss in charge.

The Adams fund work of the station progressed satisfactorily along well-defined outlines. The study of factors affecting the efficiency of sugarhouse evaporators, which is an outgrowth of the fuel experiments, was continued. A special evaporator designed and installed for experimental work was constructed, so that all of the necessary measurements and observations in the study of heat transmission and entrainment in vacuum evaporators under varying conditions could be made. This equipment was under operation for a series of tests from which data were tabulated. In addition to this work seven tests of evaporating machinery were made in three sugarhouses, and in all of these steam consumption and water evaporation were measured, temperatures were taken at necessary points, and a complete tabulation of the data was secured. A technical bulletin on experiments with oil burning in boiler furnaces was issued by the station during the

year, and preparations were made to publish completed data along these lines in another bulletin.

Studies of methods of clarification of juices and sirups, evaluation of molasses, and testing sugarhouse products were continued, and a bulletin reporting some of this work, and bearing in part upon the problem of deterioration of sugars in storage, was completed for publication. Considerable additional information was secured on methods of clarification with special reference to the modified carbonation process and on the improvement of the ordinary sulphitation process by removal of the sulphur precipitate before adding the lime. Marked progress was also made in the evolution of a method for determining the true sucrose of deteriorated sugar products, and of satisfactory methods for determining the true sucrose content of low-grade molasses. The results of this work, combined with other results on refractometric analysis of cane products, were published as Bulletin 135. In addition, eight articles on different phases of this work, all of a technical nature, were prepared for publication in various journals.

Progress was also recorded in the study of the effect of moisture on the bacterial deterioration of sugar, acidity coefficient of sugars, effect of inoculation of sterile sugars with various pure and mixed cultures, and the effect of sterilization of sugars with ether, formaldehyde, toluene, chloroform, and other substances. Better methods for securing sterilization of crystallized sugars for experimental use and a method for determining the amount of gum in partially fermented sugars were elaborated, and these will facilitate the further prosecution of the investigations. Additional information was also secured in regard to the influence of moisture content of sugars on bacterial growth and inversion, and on the effect of organic acids upon the gum fermentation of sugars.

Entomological work recently begun under the Adams fund was confined to the study of the life history of insects injurious to stored rice not heretofore investigated. Some of these species were reared under artificial conditions for the observation of their complete life cycle. Parasites of some of the insects were secured and parasitism was made a feature of the investigation.

Among the plant pathological projects the study of the cotton-boll rots was practically completed and the bulletin giving the results of the investigation was prepared for publication. This work has resulted in the suggestion of some means of aiding in the control of these diseases and has given a number of facts regarding the causative organisms which represent a distinct contribution to science. Further verification of the possibility of applying results of previous investigations to the control of bean anthracnose was carried on, and the study of a sclerotium disease of peppers, including observations on its occurrence on a large number of other plants, was continued. The study of cotton wilt was confined during the year mainly to selection

for resistant varieties. A report of progress in studying the red rot of sugar cane was made in bulletin form. It was found that this disease was particularly injurious on borer-infested cane.

The animal pathologist devoted himself to investigations on anthrax and cooperated with the plant pathologist in a study of cottonseed-meal poisoning which has so far resulted in the elimination of a number of substances previously suspected of being associated with the poisoning effect. The study of the dissemination of anthrax by buzzards, dogs, cats, hogs, opossums, chickens, and flies was continued, and a bulletin was prepared on the results of experiments in which charbon carcasses were fed to these animals and the influence of passage through the digestive tract on the anthrax organism was observed.

The work with Hatch and other funds at the sugar station was much the same as in previous years, including experiments in sugar making, tests of seedlings and varieties, methods of culture, and fertilizing of sugar cane, and especially of methods of protection against the sugar-cane borer. The fertilizer experiments included a comparison of different forms of nitrogen, such as ammonium nitrate, sulphate of ammonia, cottonseed meal, tankage, and cyanamid nitrogen. To the existing collection of cane seedlings and varieties, 385 seedlings of Louisiana origin and 148 varieties grown from cuttings from foreign countries were added during the year, and several varieties considered worthy of propagation were tested on larger plats. A large part of the cane seedlings was destroyed by hail during the year and considerable damage was also done by the cane borer in the reduction of yield and quality of the varieties of cane under test.

At Baton Rouge, 60 acres of land adjacent to the station farm were acquired and will be devoted largely to experimental work, including cooperative test work with this department in seed and plant introduction.

The work of the veterinary department was especially fruitful in promoting interest in tick eradication and aiding in the suppression of hog cholera. More dipping vats were constructed throughout the State during the past year, largely as a result of this work, than in all previous years of the tick-eradication campaign.

The work in agronomy included experiments with cotton, corn, oats, and various forage crops and involved tests of methods of culture fertilizers, cover crops, and rotation. Particular attention was given to the production of feeds for hogs and sheep, and a bulletin on lespedeza or Japan clover was published early in the year.

In animal husbandry, hog-feeding experiments progressed satisfactorily and verified results previously obtained. With dairy cattle, feeding tests were conducted and the composition and amount of manure obtained from dairy cattle with the various feeds found in the open market were determined. A study was also made of the

relative value of succulent and dry feeds of the same composition in digestible carbohydrates, fat, and protein.

The horticultural work related mainly to questions of packing and shipping and the improvement of vegetables by selection. Cooperative work in selection for disease resistance was carried on with the plant pathologist.

At the North Louisiana Experiment Station, hogs were successfully fed in carload lots on a succession of crops. Experiments in production of crimson-clover seed were continued, as well as in the selection and breeding of potatoes, beans, tomatoes, and melons. With the acquisition of additional land, experiments in the improvement of woodland pasture were begun and preparation was made for more extensive experiments with cattle and hogs. A new residence for the superintendent was constructed at a cost of about \$4,000 to replace the previous residence, which was burned.

At the rice experiment station, the crop of 1912 was the best ever secured and the results were very encouraging, especially in the work with rotation of crops and the improvement of land by means of cowpeas. This station maintains work in cooperation with this department, which includes observations on varieties of rice, their botanical characters, and studies on evaporation of water from rice fields, together with a compilation of temperature records and other data.

The publications received from this station during the year were as follows: Bulletins 127, Sugar Cane Seedlings; 128, Bagasse Drying; 129, Cane-sirup Making; 130, Lespedeza, or Japan Clover; 131, Experiments with Oil Burning in Boiler Furnaces; 132, A Simple, Effective, and Inexpensive Method of Treating the Arsenical Dipping Solution Before Emptying Vat for Cleaning; 133, The Red Rot of Sugar Cane; 134, Some Studies on Cottonseed Meal Poisoning; Fertilizer Report, 1910-11; Feed Stuffs Report, 1910-11; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	24,500.00
Fees, including balance from previous year.....	27,072.12
Farm products.....	4,578.04
 Total.....	 86,150.16

The Louisiana stations are pursuing many lines of scientific and practical work with an important bearing on the agricultural problems of the State. Results already obtained have thrown valuable light especially on questions relating to the technical phases of sugar manufacture and more efficient sugar-house management, and to the control of plant and animal diseases.

MAINE.

Maine Agricultural Experiment Station, Orono.

Department of the University of Maine.

C. D. Woods, Sc. D., *Director.*

The changes on the staff of the Maine station during the year were confined to several subordinate positions. Shortly after the close of the fiscal year, O. A. Johannsen, entomologist, resigned to accept a position at Cornell University. W. J. Morse, plant pathologist, completed his work for the doctor's degree during the year at the University of Wisconsin. Improvement work on the new farm at Highmoor was continued, and practically the entire farm has now been put on an experimental basis.

As in the previous year, the Adams fund investigations constituted a large part of the station's work. The studies relating to poultry breeding, the most extensive of the different lines, were actively pursued and brought near to completion. Considerable time was occupied in working over the great mass of data secured in these investigations and preparing reports on the same. The experiments in breeding for egg production approached their close with the final conclusion that high productiveness is a hereditary character transmitted through the male, the female fowl never transmitting the hereditary factors to her daughters.

Studies of certain features of inheritance in breeding, previously carried on with corn at Highmoor farm, were continued with beans and oats. With beans about 200 individual selections were planted in such a way that observations could be made on each single plant. The beans of each individual plant were subjected to laboratory studies for the purpose of determining points of variation and other factors. Similar individual selections and laboratory studies were made with oats to determine what individual plants carry yielding capacity, freedom from disease, and other desirable qualities in hereditary form.

Much additional material was accumulated and put in shape for publication during the year for monographs on Psyllidæ and Diptera, and for reports on hymenopterous and dipterous parasites. Further results secured in the study of fungus gnats, with special reference to the Mycetophilidæ, including many genera, were published in bulletin form.

Other lines of Adams fund work included studies on the identity of organisms causing leaf spot, fruit decays, and canker of apples, on different forms of *Fusarium*, and on the organism of blackleg of potatoes which was secured from different sources. In the absence of the plant pathologist, almost no work was done on the potato-scab project.

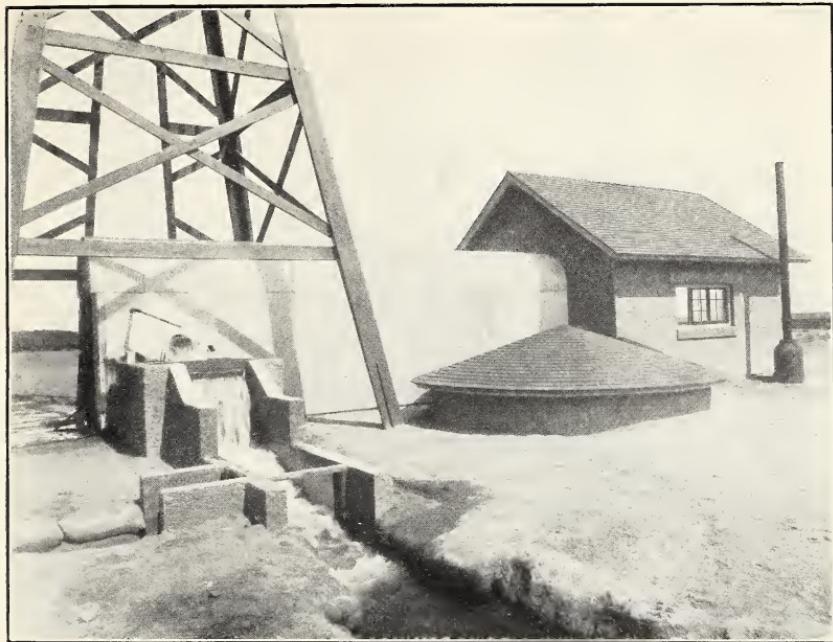


FIG. 1.—PUMPING PLANT, GARDEN CITY, KANS., KANSAS STATION.

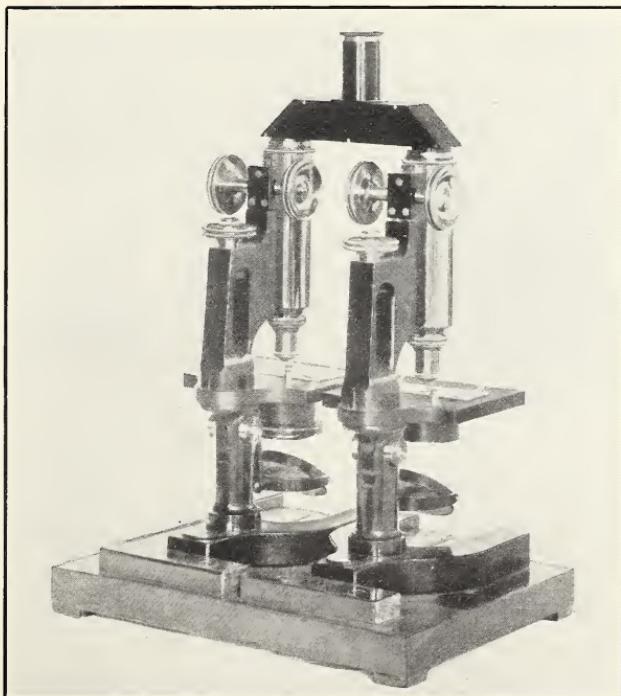


FIG. 2.—COMPARISON OCULAR, KENTUCKY STATION.

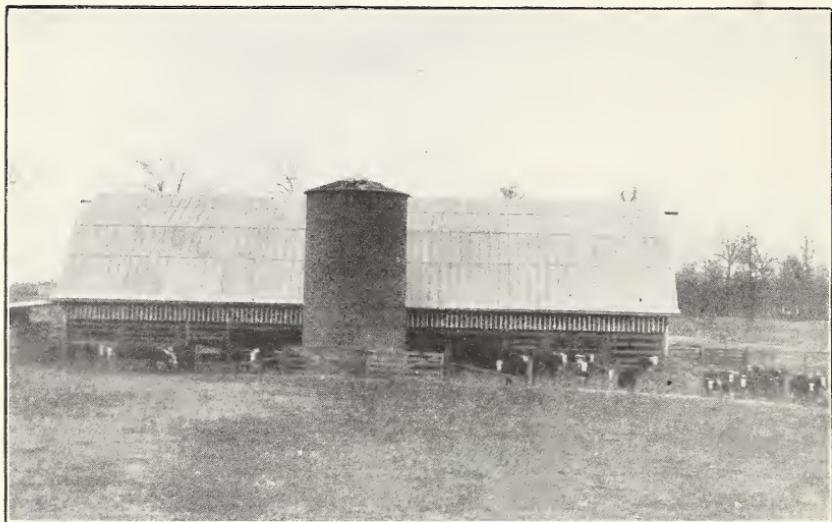


FIG. 1.—CATTLE FEEDING BARN, MISSISSIPPI STATION.

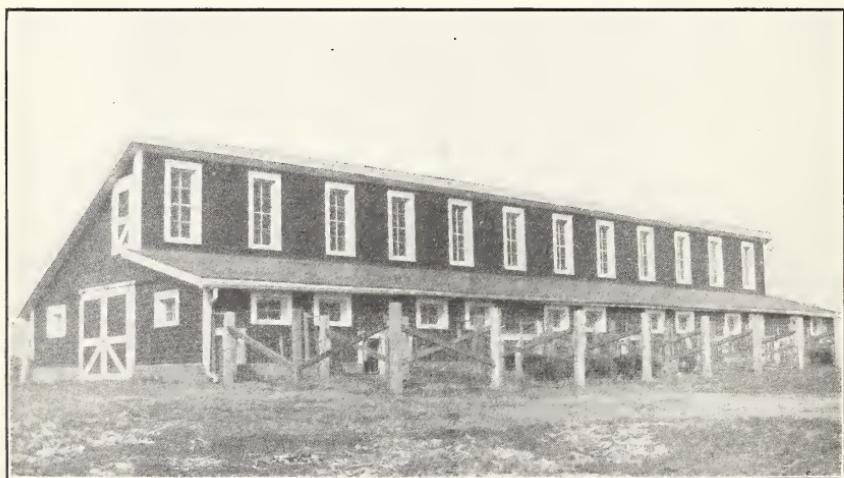


FIG. 2.—HOG BARN, MISSISSIPPI STATION.

In close connection with the Adams fund projects a considerable number of other lines of work were conducted with other funds. An ear-to-row test with Cornforth corn to secure pure strains was continued, and apparently a very valuable strain has been obtained. This corn was grown under a system of controlled fertilization to free it from undesirable qualities and to fix the strain. The best lines which showed vigor and fine quality were propagated on a more extensive scale. Variety tests of oats, together with the isolation and propagation of pedigree strains, were continued.

Work on poultry management included the construction and installation of an approved brooder, observations on methods of feeding, and keeping records of all matters concerning the station flocks. A special study was made of the reliability of trap-nest records. Crossing fowls to secure a utility type has given important results. A monographic study of Barred Plymouth Rock eggs was continued during the year and a large amount of valuable material in this direction was accumulated.

The department of entomology completed investigations on *Macrosiphum destructor* and *M. solanifolia* and reported the results. The distinctive structural characters have been carefully worked out so that the two species can be distinguished in all their forms regardless of the plant on which they feed. Important additions were made to the list of native food plants which have a bearing on the economic status of aphids. Progress was made in preparing an insect host plant catalogue and in conducting tests of poison baits for the railroad worm. Various methods recommended in the past for the extermination of wireworms in sweet-corn fields were compared and more recent methods were given trial. The seed was treated with various poisons and repellents, but the only test promising good results was the planting of field peas in rotation.

Cooperative experiments on the control of blackleg in potatoes were conducted on eight different farms under field conditions, and the results obtained were interpreted as showing conclusively that the disease can be eradicated by selection of sound seed tubers and their disinfection with formaldehyde. In the study of a stem disease of ornamental plants, a fungus was isolated from diseased stems which was found to cause the disease upon inoculation.

In connection with horticultural work, attention was given to orchard renovation and laying out new or more extensive experiments at the Highmore farm. The tests of cultivation of orchards as compared with pastureage with sheep and swine were brought to a close. The methods of pruning and spraying used to renovate the apple orchard gave very gratifying results. Comparative tests of organic manures and chemical fertilizers were continued, as was the study of the relation of stock and scion in apples. Crossing of apples

was continued and a number of cross-bred apples were secured, and in addition a number of seedlings were grown from standard varieties.

There were also in progress during the year at the Highmoor farm rotation experiments with sweet corn, oats, and grass, with and without manure and fertilizers; tests of the so-called mineral fertilizer; experiments in top-dressing grass; and cultural and fertilizer experiments with potatoes.

The publications received from this station during the year were as follows: Bulletins 190, Two Species of Macrosiphum; 191, Method for Determining Weight of Parts of Eggs; 192, Breeding Poultry for Egg Production; 193, Poultry Notes, 1910; 194, Control of the Blackleg or Black-stem Disease of the Potato; 195, Insect Notes for 1911; and 196, The Mycetophilidae of North America, III.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	5,000.00
Fees.....	17,000.00
Farm products.....	8,804.45
Balance from previous year, miscellaneous.....	1,364.10
Total.....	62,168.55

The Maine station is making good progress. Its work covers the agricultural problems of the State to the fullest extent feasible with the funds at its disposal, and is to an unusual extent of high-grade character. Certain results of its investigations constitute distinct contributions to science.

MARYLAND.

Maryland Agricultural Experiment Station, College Park.

Department of Maryland Agricultural College.

H. J. PATTERSON, B. S., *Director.*

The Maryland station during the past year continued its work actively along the lines previously in progress. The amount of new work inaugurated was limited by the availability of funds. Some minor improvements were made in equipment, and the changes on the staff included the resignation of G. E. Gage, biologist, with the appointment of B. M. Bolton as his successor, and the resignation of C. P. Close as horticulturist. Since the close of the year the station entered upon seed-inspection work under the direction of the State board of agriculture, which has an appropriation of \$2,000 for the purpose. C. P. Smith was put in charge of this work in addition to other duties. The State made provision for a State biological laboratory by appropriating \$5,000 for equipment and \$5,000 annually for 1913 and 1914 for maintenance. The functions of this laboratory will include the hog-cholera serum work.

The Adams fund work of the station progressed steadily, and in some lines definite results ready for publication were attained. The milk investigations had special bearing on the cellular content and the presence of fibrin as an index to the existence of inflammatory processes in the udder.

The study of the physical differences in the proteids of milk from different breeds of dairy cows was completed and the results tabulated. Measurable differences were established in the precipitating characters of these proteids when the natural acid of the stomach was used in different strengths. By means of these reactions the existence of abnormalities in the milk was also determinable. A study of the relations existing between the proteids of the milk of different breeds of cows was interrupted by the development of disease among the rabbits used as test animals.

The investigation of white diarrhea in chickens was continued, with special reference to the causes of development of the organism and methods of control, problems connected with the etiology of the disease having been previously solved. Inoculation experiments were made with cultures of the causative organism for the purpose of conducting further studies.

The entomological work, in continuation of previous investigations, consisted principally of the study of the systematic, biological, and economic aspects of the braconid subfamily Opiinae. This work resulted in a good understanding of this group and showed the need of a complete revision of its classification, which was entered upon. Breeding work, pursued to gain a more satisfactory knowledge of the biology of the group, was held within narrow limits on account of the appearance in small numbers of the phytophagous Diptera, which constitute the principal host. Valuable notes on several of the parasites, as well as on a number of the Diptera, were secured.

The study of the effects of fertilizers on the cell structure of crops and their relation to mutations was continued, principally with tomatoes, but work was also done with corn, cowpeas, and other crops. The plants were grown in field plats and in the greenhouse on benches and in small sand cultures. It was found that the use of different fertilizers seemed to influence the cells chiefly in size and number. In the case of tomatoes the fertilizers appeared to affect the characters of the plant, and some new varieties with apparently fixed characters of their own have been developed.

The investigation of the effect of internal application of different substances to plants was carried forward along the same lines as heretofore, but in addition the study of lipoids was taken up. Studies on the metabolism of tubers were continued and numerous data were gathered. The investigation of the chemical processes in tubers during the dormant period with reference to their relation to germina-

tion involved studies of the enzymes and of the performance of carbohydrates, fats, and proteins under different conditions. In this connection studies were made of changes in potatoes during storage and of "little sprout" disease of potatoes to determine for this disease the inhibiting factor and the effects of temperature. The influence of chemicals applied to tomatoes was considered, with special reference to the development of two species of parasitic fungi, and the number of days required for the fungi to germinate was determined.

The study on the diffusion and depletion of lime in the soil, continued as heretofore, included the determination of the physical and mechanical effects of lime on different kinds of soil. The results secured in the work on the cause of the loss of lime from soils were prepared for publication.

Arrangements were made to facilitate the taking of body measurements of dairy animals, and a study of the relations of these measurements was inaugurated.

A number of different lines of work in addition to those mentioned were supported by the Hatch fund. The work of the horticultural department was classified under the heads of pomology, stone fruits, and vegetables and floriculture. Hybridization experiments with pears were made, and a number of hybrids of fruiting age, including some of very desirable quality, were compared. Some of this work was carried on with seedling trees, to make observations on the extent of variation. A cooperative fertilizer test with peaches and apples was conducted as an outlying experiment. Breeding work was also done with grapes and with strawberries to secure fall bearing strains. A new plantation of blackberries was established. Special attention was further given to tomatoes, roses, carnations, and mushrooms. Greenhouse experiments with tomatoes included breeding work and studies on the effect of fertilizers on plant characters. Observations were also made on the use of lime in treating the soil of greenhouse benches as a means of disease prevention, on the behavior of introduced disease-resistant strains of muskmelons, and on the time of applying fertilizers in asparagus culture.

In different localities the plant pathologist made tests of spraying tomatoes and potatoes for the purpose of working out methods especially adapted to local conditions. Tests of resistant varieties of tomatoes obtained from the Tennessee station were made on soils where wilt had been prevalent, and plants of commercial varieties were selected with reference to their relative resistance for use in future work.

The entomologist tested a considerable number of insecticides for the woolly aphid in both nursery and orchard. Experiments in banding trees for this insect gave negative results. Studies were made of the strength of cyanide of potassium required to fumigate

various crops in greenhouses during night and day and under wet and dry conditions. The study of the peach-tree borer was completed, the life history having been fully worked out, and numerous remedies were tried. A test was made of solutions of formaldehyde of different strengths as a means of controlling flies in dairy barns, and it was found that a half per cent solution was satisfactory and materially reduced the number of flies. Attention was further given to outbreaks of army and pickle worms in the State.

The agronomist continued work along the same lines as enumerated in last year's report, giving attention mainly to the breeding of grain and forage crops and testing varieties and cultural methods. The crops mainly entering into the work were corn, wheat, winter oats, barley, spelt, emmer, sweet corn, alfalfa, vetch, and clover.

In poultry husbandry, feeding and incubator experiments were continued, and records were kept of the egg production of different groups of fowls during the year. A study of the cause of leg weakness in chicks was also in progress.

The publications received from this station during the year were as follows: Bulletins 153, *Bacteria and Animal Organisms Found in the Feces and Intestinal Mucosa of Healthy Chickens*; 154, *Bee Keeping in Maryland*; 155, *Maryland Weeds and Other Harmful Plants*; 156, *Rose Mildew*; 157, *Some Experiments with Poultry*; 158, *Miscellaneous Greenhouse Experiments*; 159, *Peach Culture*; 160, *Strawberries*; 161, *Treatment for the San José Scale and Terrapin Scale Insects*; 162, *Results of Seed Analyses*; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation, including balance from previous year..	14,451.41
Farm products, including balance from previous year.....	9,073.35
Total.....	53,524.76

In general, the affairs of the Maryland station are in good condition. Its equipment has been considerably improved, and it enjoys the confidence of the farmers of the State in increased measure.

MASSACHUSETTS.

Massachusetts Agricultural Experiment Station, Amherst.

Department of the Massachusetts Agricultural College.

W. P. BROOKS, Ph. D., *Director*.

The Massachusetts station during the past year continued to enlarge its staff and to improve its equipment. Several assistants were appointed in chemistry and one each in horticulture and agronomy. C. E. Marshall, of the Michigan college and station, appointed director

of the graduate school and professor of microbiology during the year, was also placed in charge of research work in dairy bacteriology. A State appropriation of \$4,500 for experimental work with poultry was made available December 1, 1912, and additions were made to the college poultry plant in preparation for breeding experiments. A new dairy building costing about \$75,000, and containing laboratories for experimental work, notably for investigations in dairy bacteriology, was about completed. A new law for the inspection of feeding stuffs and a revised law for the inspection of dairy utensils were enacted during the year, their enforcement being placed in the hands of the station. The inspection work of the station was large as heretofore.

A new Adams fund project, the interrelations of stock and scion in apples, was successfully inaugurated on a 20-acre tract adjoining the station grounds, providing nearly 4,000 trees for use in the investigation.

The breeding experiments with peas in progress for several years were in the main completed and the data prepared for publication. The results indicated that the common varieties of garden peas consist of mixtures of strains, each having its peculiar characters as to vigor and productiveness. These strains appeared relatively fixed, and in order to test this question work in selection within the strain was continued. Correlation studies were made of vine length in parent and offspring, of vine length and weight of seed peas, and of vine length and weight of peas produced. The plant-breeding work further included studies on Mendelian inheritance in beans, squashes, and nasturtiums. The investigation on variation in the fruit of apples was continued, nearly 2,000 specimens being studied. Work on physiological constants, also in charge of the horticulturist, was held in abeyance during the year.

The study of the principles underlying the use of fertilizers in cranberry culture was carried on at the cranberry substation at East Wareham and on the small tile bogs at the station. Chemical studies of the drainage water of the bogs showed the losses of nitrogen, phosphoric acid, and potash per acre, and pointed out that much of the organic matter, all of the phosphoric acid, considerable of the nitrogen, and a large part of the iron contained in the bog water exists in a colloidal mass, which remains almost continuously in suspension. Methods of removing this mass for study were determined.

The work on cranberry insects followed the lines of previous years, and a large amount of data relating to both injurious and beneficial insects was collected. The investigations indicated the probable control of the cranberry fruit worm and threw some light on the relation of insects to the fertilization of cranberry blossoms.

Studies on the importance of the digger wasps as parasites were continued, and a paper incorporating some of the more technical pre-

liminary data was completed. Progress was made in the study of vision in bees in devising helpful apparatus and in accumulating significant data bearing on the subject, not only with bees but also collaterally with other related insects.

The investigations with asparagus were pursued along the lines originally laid down, special consideration being given to the influence of fertilizers on rust resistance and on the growth and composition of the plant. The work of breeding rust-resistant types conducted in cooperation with this department progressed favorably. Ash analyses of roots were made to determine the effect of varying amounts of different plant food elements on the composition.

Investigations on the chemical action of sulphate of ammonia on soil were undertaken systematically during the year. Extracts obtained from soils of different plats by treatment with different concentrations of ammonium sulphate solutions were studied, together with drainage waters from some of the plats. A study was also made of the leaching effect of sulphate of ammonia on the soil bases in comparison with nitrate of soda.

In the study of milk secretion substantial progress was made in perfecting a method for the quantitative determination of the various insoluble fatty acids in butter fat, in the milk of fresh cows, and stripers of the Jersey and Holstein breeds under normal feeding. In continuation of investigations on the chemistry of fat and fat formation, several series of samples were analyzed and the physical and chemical changes in some of the series were studied.

The chemical study of the burning of foliage by arsenicals was practically completed. In this connection it was found possible to prepare in the laboratory salts of theoretical molecular ratios. Some work was done by the entomologist on the effect of these compounds on foliage.

In the investigations on the effect of molasses on digestion, experiments of two years ago relative to the effect of molasses in producing an increased action of the intestines were repeated. These studies confirmed the previous results.

Studies of the relations of climate to the development of plants and crops, covered, as heretofore, a wide range of ecological studies. Special consideration was given to the effect of light on plants in health and disease, and papers on this phase of the subject were prepared. A study was also made of the relation of moisture and electricity to plant growth.

The work carried on with Hatch and State funds covered a wide range of activities. The experiments with field crops included, as in previous years, field, cylinder, and pot experiments to compare fertilizers, varieties, and cultural methods on a variety of field crops, fruits, and vegetables at the station, the substations, and at various

places in the State. Progress was made during the year in perfecting methods of predicting frosts and in methods of protecting cranberry bogs against frost.

Studies of the keeping qualities of different varieties of apples as affected by environmental factors were begun with the new cold-storage house completed during the year. Tests of the cooking quality as affected by environment were also undertaken and other features of local adaptation of apple varieties were given attention.

Digestion experiments on sheep were carried on, as well as tests of alfalfa as a partial or exclusive ration for milch cows, comparisons of light and heavy grain rations for cows, and of milk substitutes for calves.

The work of the entomologist included tests of different brands of insecticides, observations on wireworms, distribution of insect pests in the State, date of hatching scale young, and continuation of studies on onion thrips, and tests of methods of treatment of the onion maggot.

The botanist carried on various investigations on the distribution of plants as affected by humus content of the soil and other factors; effect of varying moisture, oxygen, and soil texture on the germination of seed; the physiology of spray injuries or stimulation; effect of light and gases on respiration in plants; effect of atmospheric electricity on growth of yeasts and sunflowers; electric resistance of trees and their protection against lightning; seed examination and grading; and improving spray nozzles and apparatus.

The publications received from this station during the year were as follows: Bulletins 138, Diseases of the Tomato; 139, Inspection of Commercial Feed Stuffs; 140, Inspection of Commercial Fertilizers; Meteorological Bulletins 270-281; Circulars 30, Balanced Rations for Dairy Stock; 31, Lime and Sulphur Solutions; 32, An Act to Regulate the Sale of Commercial Fertilizers; and the Annual Report for 1910, parts 1 and 2.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation, including balance from previous year..	17,761.90
Fees, including balance from previous year.....	10,277.00
Farm products.....	6,613.10
Miscellaneous.....	8,143.69
Total.....	72,795.69

The activities of the Massachusetts station are constantly increasing in scope and amount, and now include many lines of research work and of general experimentation at the station, substations, and in cooperation with farmers. The station has a strong following in the State.

MICHIGAN.**Experiment Station of Michigan State Agricultural College, East Lansing.**

Department of Michigan State Agricultural College.

R. S. SHAW, B. S. A., *Director.*

Several changes occurred in the personnel of the Michigan station staff during the year. C. E. Marshall, scientific and vice director and bacteriologist of the station, resigned to accept the deanship of the Graduate School of Agriculture and the professorship of microbiology at the Massachusetts Agricultural College. W. G. Giltner was selected as acting head of the bacteriological department, and the position of research assistant vacated by him was filled by the appointment of E. T. Hallman. O. Rahn, assistant in bacteriology, resigned to accept a position at the University of Illinois, and F. H. H. Van Suchtelen entered upon his work as research assistant in bacteriology during the year.

The Adams fund projects remained unchanged throughout the year, and in a number of them satisfactory progress was made. In the studies in dairy bacteriology considerable work was done on the souring of milk and the changes in butter during storage was followed. Not much progress was made in the project on swine epidemics. The study of the organic nitrogenous compounds in soils and their variability, together with the study of the chemical factors rendering soluble the insoluble phosphates of the soil, was continued cooperatively by several of the station departments, and results bearing on different phases of the problems involved were prepared for publication. Work was begun during the year on the physiological factors in plant growth as related to the soil and more particularly to the soil moisture. Considerable progress was attained in the study of the chemical factors affecting plant growth in solutions and soils, special consideration being given to the relation of soil particles to plant adsorption. Pot experiments and laboratory work were conducted in a study of organic matter with a bearing especially on peat as a source of organic matter and incidentally on its use as a reinforcement of manure. The object of the laboratory work was largely the separation of decomposition compounds. The work with phosphates had to do largely with the study of methods for rendering insoluble phosphates soluble. A method of preparing a neutral solution for the determination of phosphoric acid was developed and a paper on the subject was published.

The soil physicist worked on temperature problems, and in this connection designed special apparatus for study on induction of heat. An experiment on radiation of heat and one on absorption were completed, and considerable work was done on specific heat in soils as related to those factors. Studies were also conducted on the

movement of heat in field soils, and continuous records to serve as checks on the laboratory work were made on soil temperatures at three depths under three sets of conditions, and in clay, loam, muck, gravel, and sand.

The results of work on insecticides published during the year as a technical bulletin showed, among other things, that kerosene, gasoline, and other contact insecticides of a more or less volatile nature become effective against insects mainly through absorption into the insect tissues of their volatile portions. It was found that the vapors from such insecticides entered the insect tissues and became effective long before the liquids as such had time to penetrate the chitin, and that their comparatively rapid influence did not come from the plugging of the trachea alone. The efficiency of lime-sulphur was determined as due to its strong persistent reducing power, and its ability to soften the wax about the margin of certain scale insects.

The investigation of the twig and branch cankers of fruit trees proceeded as previously outlined. Some work done in the northern part of the State included successful inoculations and an endeavor to find out the actual pathologic effect of the organism isolated.

Under the Hatch fund the work in agronomy included field experiments in good condition and systematically planned and conducted. Plant breeding work was carried on extensively with wheat, oats, and alfalfa, while similar work on a smaller scale was done with barley, rye, field beans, soy beans, cowpeas, clover, timothy, and orchard grass. Breeding experiments begun with corn were based on three years' work with corn varieties. The control of fertilization of clover by insects received attention and variety tests of alfalfa were planned with reference to relative seed production. Field tests conducted largely by the Michigan Experiment Association, composed of graduates of the college and others, were made in different parts of the State with improved varieties of wheat, oats, and alfalfa bred by the station. Data were collected for a bulletin on alfalfa including the results of growing the crop in different parts of the State. Crop work in its relation to soil fertility was conducted on 120 plats and included 24 different rotations and 12 different treatments with manures and fertilizers.

In horticulture, spraying tests were made on potatoes, cherries, and apples, and experiments were carried on with fertilizers for apples, peaches, and grapes. Cover crops for orchards and vineyards were tested. Attention was given to cold-storage problems, and studies were made of celery and tomato production in regions of the State devoted to these crops. Experiments were further conducted on top working early on late varieties of pears and new varieties, on Kieffer pears to observe the possible effect on disease resistance and

other factors, and breeding work was carried on with tomatoes and lettuce.

The entomologist continued to study parasites of the tamarack sawfly with a view to its control and introduced material for this purpose with which breeding experiments were made. Spraying tests, including a comparison of oil preparations with lime-sulphur in combating oyster-shell scale and other insects, supplemented the work on lime-sulphur with special reference to improving the efficiency of this spraying material. The life histories of a number of insects, including one occurring on box elder, were being worked out and the Orthoptera of the State were being collected and studied. A bulletin on scale insects was prepared.

The studies of the bacteriological department involved problems relating to causes of off-flavors in milk and butter, infectious animal diseases, methods of application and results of legume inoculation, sanitary aspects of water supplies and sewage disposal, particularly from the standpoint of the farm and small village, and also studies of the bacterial disease of the June-bug larvæ.

The botanist made special studies of diseases of ginseng, peaches, and other plants and investigated the pathology of fairy rings. Other lines of work included studies of treatments for the control of bean anthracnose and bean blight, loose smut of wheat, and of potatoes for the control of diseases carried over in the tubers.

The chemist made a cooperative study of mineral elements removed from the soil by the growth of certain bush and vine fruits, and also studied the lime and carbon dioxide content of acid soils. Analyses were made of 25 or more samples of wheat grown in the breeding experiments of the department of agronomy and of the so-called brush hay made by chopping up small portions of birches and other trees. Some attention was also given to analytical methods.

The work at the South Haven substation included variety tests of apples, peaches, and small fruits, and spraying experiments with Bordeaux mixture, commercial lime-sulphur, and self-boiled lime-sulphur in apple and peach orchards in the vicinity. The work at Chatham was largely confined to clearing the land and making other preparations for work. About 100 acres have now been cleared, and the erection of a dairy barn 36 by 72 feet, a poultry house 16 by 32 feet, and a piggery was undertaken. A flock of 259 yearling wethers was turned in on the land to aid in suppressing weeds, sprouts, and other growth.

The publications received from this station during the year were as follows: Bulletins 264, Second Report of Grade Dairy Herd; 265, Fertilizer Analyses; 266, Poultry House Construction and Yarding; 267, Michigan Weeds; Special Bulletins 55, Analyses of Miscellaneous

Materials; 56, Tile Drainage; Technical Bulletins 7, Organic Nitrogenous Compounds in Peat Soils, II; 8, Studies of Agglutination Reactions in Hog Cholera During the Process of Serum Production; 9, The Influence of the Products of Lactic Organisms upon *Bacillus typhosus*; 10, The Fermenting Capacity of the Average Single Cell of *Bacterium lactis acidi*; 11, How Contact Insecticides Kill; Circulars 11, Lime for Agricultural Purposes; 12, Tuberculosis in Fowls; 13, Winter Vetch for a Cover Crop in Michigan Orchards; 16, Sandy Soils of Western and Northern Michigan; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	6,000.00
Fees.....	5,420.00
Miscellaneous.....	3,133.73
Total.....	44,553.73

The Michigan station has a fine plant in land and buildings, and its general influence in the State is large. The recent losses of men, however, and the inadequacy of its present funds threaten to seriously affect its work and will retard its development unless corrected.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota, University Farm, St. Paul.

Department of the University of Minnesota.

A. F. Woods, M. A., Director.

The year at the Minnesota station was one of general progress. Among the changes occurring on the station staff may be mentioned the appointment of R. M. Washburn, of the Vermont station, as assistant dairy husbandman, and W. L. Boyd to succeed B. A. Beech as research assistant in veterinary science. H. R. Smith, of the Nebraska station, entered upon his work as animal husbandman on February 1, 1912. A new building for agricultural engineering to cost about \$255,000, including equipment, was in course of construction. Research work in agricultural economics was organized with C. W. Thompson in charge.

Definite progress was reported on all the projects conducted with the Adams fund. Some of the results secured in the investigation on the influence of methods of farming on the fertility of characteristic soil types of the State were published during the year in Bulletin 128 of the station, which discussed in particular the relation of different systems of crop rotation to humus and associated plant food. It was found that the amount of humus runs concurrently

with the total carbon and nitrogen. In continuous cropping experiments, the humus content fell, while in rotations involving grass and various leguminous crops it was maintained. Work on soil absorption was taken up during the year.

In the department of animal husbandry and dairying the principal work under the research fund was on the relation of type of animal to beef production. This investigation was continued as originally outlined with 60 steers fed from birth to the age of two years, and comparisons were made between continuous stall feeding and feeding supplemented with pasture. Twenty of the steers were slaughtered for analysis, and the data obtained pointed out important facts regarding water, ash, protein, and fat in the animal body. The study of food requirements for milk production was continued as formerly, and the results of several years' work were prepared for publication.

The investigation in stable ventilation was nearly completed. Six animals, four in closed stalls and two in open stalls as checks, were used in this experiment, and at its close they were slaughtered and different organs were taken for analysis. The work also included studies on the opsonic index and the bactericidal effect of the blood. The results obtained during the year confirmed those previously reported, indicating that variations in carbon dioxid or in oxygen are of less importance in stable ventilation than has been generally supposed, and that while improper ventilation may be harmful, it is because of reasons other than those previously assigned. The results seemed to indicate further that poor ventilation reduces resistance to disease.

The investigations on the rusts of cereals included studies on the nature of rust resistance, the occurrence of physiological races of rusts, and on the spread of rust mycelium in the plant tissues. The effects of various external factors on rust development were studied and investigations were conducted on plant metabolism with susceptible and resistant plants. Histological studies were pursued to determine the differences that are associated with immunity to disease. Preliminary data on the nature of rust resistance were secured.

The life-history work on *Empoasca mali* was concluded and reported upon. Some work on *Macrosiphum granaria* was carried on during the year, but most of the time was devoted to a study of *Bruchophagus funebris*, including various life-history phenomena, such as egg laying, number of progeny, dates of appearance, geographic distribution, stages in the life history, and other similar subjects. In connection with work on the larch sawfly project, which was begun during the year, collections were made of pupæ and studies were pursued on the life history of the insect, its parasites, and other points of scientific importance.

The investigations of the principles of heredity underlying disease and climatic resistance in the apple, plum, and strawberry were carried on along three lines—a study of the causes of sterility in fruits, hardiness or lack of hardiness, and the inheritance of fruit characters. A particular study was made of sterility in the grape, the work being largely cytological, to determine what causes sterility. This work was well advanced and material was collected to extend it to the plum and the strawberry. Collections of native and introduced hardy fruits were made to serve as a basis for work on fruit characters and hardiness. A large number of crosses made at the fruit farm at Excelsior entered into these investigations.

The work under Hatch and other funds was very extensive. The chemical department gave considerable attention to the study of producing alcohol from corn and potatoes. The investigation of cereals was continued with good results, and a bulletin was issued on the milling and baking value and the composition of different varieties of wheat from different parts of the State. Work on peaty soils included a study of their composition, fertilizer requirements, and agricultural values, together with the preparation for publication of the results secured during the past two years. The field work of a soil survey of some demonstration farms of the State was completed and the laboratory work in this connection was well under way.

The dairy and animal husbandry departments took up experiments to determine the types and breeds of cattle, sheep, and swine which will produce beef, mutton, and pork with the greatest economy. The determination of the value of silage for meat production and of alfalfa as a part of the ration was included in this work. In the poultry section the buildings and grounds were rearranged and records were kept of all hens so that the data might be used in future work.

The veterinarian continued the production and distribution of large quantities of serum for hog cholera prevention and the vaccination of young pigs to secure immunity to the disease. Some work with swamp fever in horses was in progress.

A plant-disease survey led to the recognition of some new diseases, particularly two serious canker diseases of apple recently imported on nursery stock from other States. Varieties of flax were tested for wilt and rust resistance, and from those notably resistant selections were made for further observations. Some preliminary investigations on corn smut were begun to determine accurately the life history of the fungus. Over 1,500 samples of grain and clover seed were tested during the year.

In entomology, considerable work was done in combating grasshoppers, especially with a poisonous spray consisting of arsenite of soda and molasses. Experiments in orchard spraying were made to

ascertain the number of applications of arsenite of lead necessary for the control of plum curculio. Cooperative spraying experiments were conducted on a number of orchards, and work was also done on the control of the clover-seed chalcis.

The horticultural department conducted various experiments with potatoes. The effect of different soils and fertilizers on degeneration of potatoes was studied, and the most promising seedlings selected from 25,000 to 30,000 grown at the station since 1908 were under observation. On the fruit-breeding farm at Excelsior the plantings were very largely extended. Special attention was given to a select lot of valuable plum hybrids derived from crossing *Prunus americana* and *P. triflora*. A large number of apples, plums, grapes, strawberries, and raspberries were studied with reference to fruiting capacity and the quality of fruit produced.

In agronomy experiments were made in plant breeding, cultural and tillage methods of various crops, crop rotation, the cost of producing Minnesota farm products, weed eradication, and farm management. A bulletin giving the results of barley breeding in Minnesota was in course of preparation. No new varieties of grain were developed during the year, but a number of new and promising sorts were grown on the increased plats as preparatory to distribution. Some work on the best methods of testing draintile, including observations on the strength of tile and the effect of freezing, and experiment on the effect of drainage on root growth was conducted by the department of agricultural engineering.

A study of climatic conditions in the Cloquet Forest Experiment Station was made in cooperation with the Weather Bureau of this department, an attempt being made to determine the influence of different forest types. Nursery practice for raising pine seedlings was studied and a detailed survey was made of the forest tract.

The publications received from this station during the year were as follows: Bulletins 123, Cutworms, Army Worms, and Grasshoppers; 124, The Cost of Minnesota Dairy Products; 125, Farm Management: Organization of Research and Teaching; 126, Lighting with Alcohol and Kerosene; and the Annual Reports for 1910 and 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	103,726.08
Miscellaneous.....	73,508.03
 Total.....	 207,234.11

The Minnesota station during the past year continued to widen the scope of its well-established lines of work, and extended its activities to new and important fields. Its influence is far-reaching and its efforts relate to all sections of the State.

MISSISSIPPI.

Mississippi Agricultural Experiment Station, *Agricultural College*.¹

Department of Mississippi Agricultural and Mechanical College.

E. R. LLOYD, M. S., *Director*.

A number of changes occurring in the staff of the Mississippi station early in the year were mentioned in the previous report. Other changes included the appointment of A. F. Rolf, of the Connecticut Storrs station, as poultryman in place of W. F. Kirkpatrick, and of C. F. Briscoe, of the Illinois station, as bacteriologist to enter upon his work at the beginning of the following fiscal year. The principal improvement in equipment was the completion, at a cost of about \$3,500, of the cattle barn and silo described in the previous report. (Pl. VI, fig. 1.) This new equipment affords improved accommodation for 100 cattle. A new hog barn, 30 by 100 feet, with concrete floor, dipping vat, and all modern fixtures, was built at a cost of \$2,500. (Pl. VI, fig. 2.) The annual appropriation by the State for the support of the three branch stations was \$26,900 with an additional \$1,500 for a residence at the Delta station.

The major Adams fund project of the station, the mule-breeding investigations, made very satisfactory progress during the year, and all the stock involved in the work was kept in good condition. The work was systematically conducted and complete photographic and statistical records were kept. The rapid increase of animals necessitated limiting the number of brood mares and of disposing systematically of the increase. Artificial impregnation was successfully employed, and the effect of mixed impregnation was tested. Several brood mares, including especially Shires and Suffolk punches, and a Spanish jack were added to the breeding stock during the year. The experiments included eight different types of mares.

The cotton anthracnose project was temporarily suspended pending the arrival of the newly appointed plant pathologist, who it was expected would continue the work.

General progress on the entomological projects was reported. The life-history studies of scale insects were continued and a bulletin on the subject, greatly delayed by loss of proof and plates in a fire, was in press. Work was also done during the year on the bean leaf-beetle and the peach-tree borer, but the study of the sugar-cane leaf-beetle was held in abeyance. A special study was made of the life histories of the less known insects affecting pecans. Much work was accomplished on the crawfish project, including a study of the biology, food habits, and means of destruction of six species, although only one species, *Cambarus hagenianus*, is of serious economic import-

¹ Telegraph address, Starkville; express and post-office address, *Agricultural College*; freight address, *A. and M. College Station*.

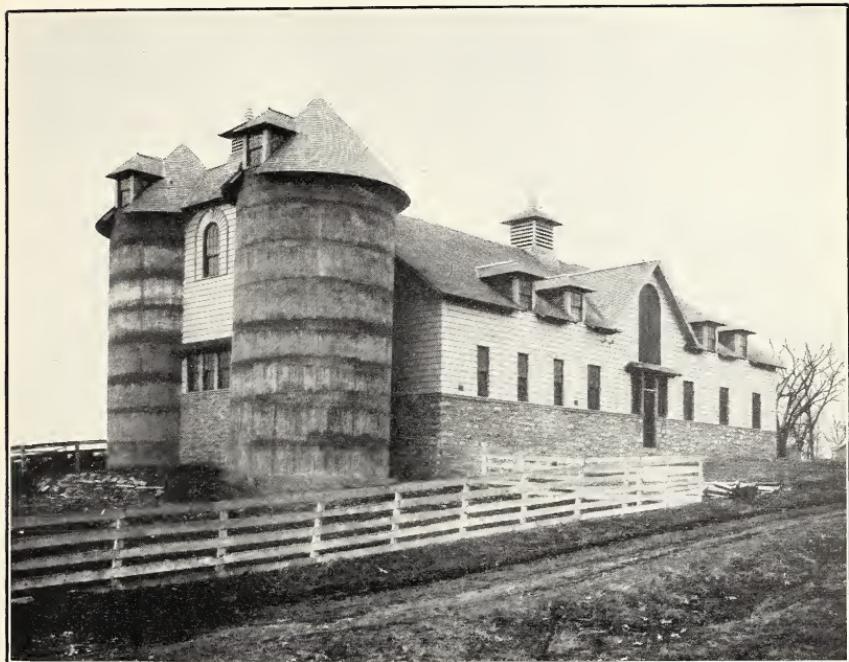


FIG. 1.—NEW DAIRY BARN WITH SILOS, MISSOURI STATION.

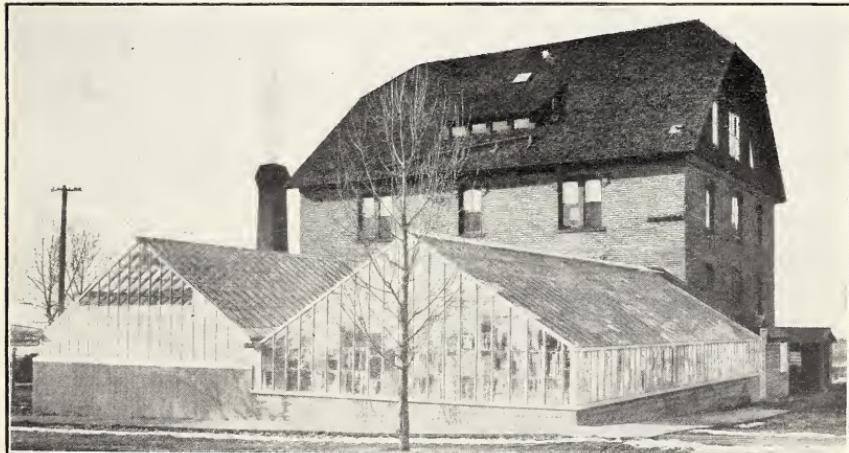


FIG. 2.—BIOLOGY BUILDING, SHOWING NEW GREENHOUSES, MONTANA STATION.



FIG. 1.—BUILDINGS AT HORTICULTURAL SUBSTATION NEAR CORVALLIS, MONT., MONTANA STATION.



FIG. 2.—BUILDINGS AT DRY-FARM SUBSTATION NEAR MOCCASIN, MONT., MONTANA STATION.

tance, especially as injuring cotton. Tile drainage and the use of carbon bisulphid were found to be effective in combating the pest.

Work in cotton breeding was conducted systematically on an extensive scale and according to the plan followed the previous year. The essential features of the investigation were a study of heredity and development in the cotton plant, breeding improved varieties of long-staple, short-staple, and disease-resistant cotton; a study of acclimatization, adaptation, or local adjustment; the determination of the extent of natural crossing; and variety testing in relation to these studies.

With Hatch funds the study of the effect of feeding cottonseed meal continuously to milch cows was continued, this being the fourth year of the experiments. At certain periods cottonseed meal was fed at the rate of 5 pounds per head per day. Distinct evidences of injury were obtained in connection with parturition and milk secretion, although the study of the blood gave only negative results. Observations were also made on the effect of feeding 2 pounds of cottonseed meal per head per day to breeding sows. Two carload lots of steers were very successfully fed with rations of cottonseed meal and hulls and hay. Feeding 2 pounds of cottonseed meal per head per day to mares and 1 pound to colts produced no harmful effects. Other feeding work included experiments with Johnson grass as a partial substitute for cotton hulls in a ration for milch cows, which was found to be of decided advantage.

With poultry, experiments on inheritance in the size of egg were continued, and studies were made of the influence of the male and of cottonseed meal and meat scrap as sources of protein. Observations on incubation and brooding were continued and a good system of records was started.

The entomologist continued to cooperate with this department in observations on the progress of the cotton-boll weevil and studied miscellaneous insects doing damage in the State during the year. Progress was made in increasing and improving the entomological collections.

In agronomy a great variety of experiments, including variety and cultural tests of cotton, corn, oats, wheat, and forage crops of various kinds, besides rotation experiments and tests of fertilizers for cotton, were in progress. Some of the varieties of cotton under observation showed considerable diversity of type. Selection experiments with these varieties were carried on, and seed was produced for distribution at the Delta branch station.

The horticulturist continued tests of varieties of small fruits, orchard fruits, and ornamentals, and pursued some cooperative work on peanuts with this department.

The publications received from this station during the year were as follows: Bulletins 146, Suggestions for Growing Home Fruits; 147, Apple Growing in Mississippi; 148, The Inspection and Analyses of Cottonseed Meal on Sale in Mississippi; 149, Inspection and Analyses of Commercial Feeding Stuffs on Sale in the State; 150, Inspection and Analyses of Commercial Fertilizers on Sale in the State; 151, The Inspection of Cottonseed Meal on Sale in the State; 152, Inspection and Analyses of Commercial Feeding Stuffs on Sale in the State; 153, Inspection and Analyses of Commercial Feeding Stuffs on Sale in the State; 154, Inspection and Analyses of Commercial Feeding Stuffs on Sale in the State; 155, Recent Cotton Experiments; 156, Inspection and Analyses of Cottonseed Meal on Sale in the State; 157, Report of Work at the Delta Branch Experiment Station for 1911; Circulars 33, Inspection and Analyses of Commercial Fertilizers on Sale in the State, and, 34 Inspection and Analyses of Commercial Fertilizers on Sale in Mississippi.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation	33,150.00
Fees	214.00
Farm products	12,294.83
Miscellaneous, including balance from previous year	4,891.06
Total	80,549.89

The Mississippi station, in spite of many changes, is making good progress and has important lines of work in hand. The results of some of its investigations, particularly those in mule breeding, are widely recognized as being of value from a scientific as well as from a practical standpoint.

MISSOURI.

Missouri Agricultural College Experiment Station, Columbia.

Department of the College of Agriculture and Mechanic Arts of the University of Missouri.

F. B. MUMFORD, M. S., *Director.*

The Missouri station during the past year continued to be progressive and prosperous. Some changes occurred on the station staff, mainly in the minor positions, but the number constituting the staff remained about the same as the year before. A building for agricultural chemistry, to form a part of the quadrangle of the college of agriculture, was in course of construction. This structure, to cost about \$65,000, will embody special provision for the slaughter work in connection with feeding experiments, including refrigerators for storage and other facilities for handling the carcasses. A new dairy barn with silo built at the station is shown in Plate VII, figure 1.

The Adams fund investigations of the station were, in general, actively pursued. Preparations for a new project on Mendelian inheritance in domestic animals, to be conducted at the outset with fowls, consisted of providing buildings and pens and purchasing stock.

Work in continuance of the study on the use of food made by steers at different ages and in different conditions involved placing under experiment 13 calves and 9 yearling heifers. These studies were continued to supplement previous inconclusive work and to confirm earlier results. Work on the effects of stunting from feeding on a low plane for a long time was conducted with the calves, and investigations on the influence of three different planes of nutrition before breeding with the heifers. A large amount of work was done on the preparation for publication of the data already in hand.

In the project on the factors influencing the chemical and physical properties of milk, underfeeding was found to have a marked effect on the composition of the fat, and it was also shown that underfeeding, as well as placing on full feed, influenced the fat content of the milk. Greater changes resulted from underfeeding than from change in feeds. A study of the yellow color of milk was made in cooperation with this department, indicating that this color is due to a yellow pigment in grass which is transmitted to the blood and is found in the milk.

The project on the influence of nutrition of heifers during their growing period on their subsequent functional activities and efficiency was continued on the same plan as in previous years. The claim that keeping heifers fat when young has an effect on the tendency to put feed into beef was not substantiated. The large amount of data accumulated indicates that milk-giving is rather a hereditary trait not affected by the feeding of the animal when growing.

The hog-cholera investigation included studies of the blood changes during immunization and hyperimmunization. Work was also in progress to establish a method of diagnosis in the field through blood examination and to determine whether an immune hog is an active carrier of hog-cholera infection. Studies were further made of organ extracts of swine affected with the disease and on the degree of immunity the mother may transmit to her pigs.

The project on age as a factor in animal breeding was continued with swine. Several generations have been bred and data regarding measurements were collected. Early mating was studied in its relation to growth in sows and their offspring.

In the investigations on the nutrition of bearing apple trees, experiments were conducted on different soil formations in seven different places and with the peach as well as the apple. The effect of the use of nitrogen, phosphoric acid, and potash on the tree and the fruit was studied. A method of bringing peach trees into bearing at an earlier

age by means of soil selection and fertilizer treatment was worked out, and the behavior of the trees with reference to water, evaporation, and wilting was determined.

Work on the dormant period of trees brought out the fact that some Japanese trees have no rest period. Other lines of investigation in connection with this project included a study of the rest period of seeds and of laboratory means of rendering the more refractory seeds ready to grow.

The studies on powdery mildews were centered mainly on the physiological relations of the mildews to their hosts. The susceptibility of different varieties of wheat and of emmer was determined and the influence of different factors was studied. The effect of the lack of certain plant food elements on the susceptibility of the plants to mildew was ascertained, together with the relation of water supply and the prevalence of the disease.

In studying the development of various parts of the corn plant, experiments were made to determine the effect of the food supply by growing plants in sand with normal and with inadequate quantities of plant food at different stages of growth. Considerable difference was found to exist in the root development of different varieties and of varieties grown on different soils. Some work was done on the effect of different ear types on the character of the plant and on the relation of cob density to kernel development.

Numerous lines of work were carried on during the year with Hatch, State, and other funds. In addition to the work connected with the animal nutrition investigations, the department of agricultural chemistry was in charge of miscellaneous work for other departments and of the chemical work involved in the soil survey and the feed and fertilizer inspection.

The dairy department continued experiments on the nutrients required for milk production, and data for eight animals are now recorded. With the same animals an attempt was made to determine the nutrients required for the development of a fetus.

The horticulturist, as in the preceding year, carried on work in breeding peaches for the elimination of the purple color. A study was also made of peach seedlings with a view to producing the greenish twig with good fruit, and work was done on the apple to secure a late blooming period. Sprayed and unsprayed apple trees were compared as to yield, freedom from disease, and quality of fruit.

The entomologist studied a number of insects, including the San José scale, the bagworm, the apple-leaf hopper, and tarnished plant bug, especially in its relation to peach die-back.

In addition to numerous experiments at the station and a series of cooperative experiments, the department of agronomy carried on work in about 20 outlying fields. The outlying work was largely

demonstration work, but it included some fertilizer, soil, and variety tests. A new experiment field, containing 40 acres, was started at Shelbina and the work inaugurated there included variety tests, culture tests, and experiments on the thickness of seeding of various farm crops, together with alfalfa trials.

The publications received from this station during the year were as follows: Bulletins 92, *The Soils of Sullivan County*; 93, *The Soils of Audrain County*; 97, *Cooperation Among Fruit Growers*; 98, *The San José Scale in Missouri*; 99, *Inspection and Analyses of Commercial Fertilizers*; 100, *Influence of Fatness of Cow on Per Cent of Fat in Milk*; 101, *Report of the Director for the Year Ending June 30, 1911*; 102, *Combating Orchard and Garden Enemies*; 103, *The Silo for Missouri Farmers*; 104, *The Evergreen Bagworm*; Research Bulletins 4, *Digestion Trial with Two Jersey Cows on Full Ration and on Maintenance*; 5, *Maintenance Trials with Five Jersey Cows*; Circulars 48, *The Plastered or Gurler Silo*; 49, *The Reinforced Concrete Silo*; 50, *Selection of Corn for Seed and for Show*; 51, *How to Prolong the Life of Fence Posts*; 52, *Growing a Woodlot from Seed*; 53, *The Seeding of Cowpeas*; 54, *Cooperative Experiments of the Department of Agronomy*; 55, *Forage Crops for Swine*; and Index to Bulletins Nos. 83-96.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	10,000.00
Fees, including balance from previous year.....	19,898.27
Farm products, including balance from previous year.....	10,706.93
Miscellaneous, including balance from previous year.....	48,993.93
<hr/>	
Total.....	119,599.13

The Missouri station is conducting a creditable amount of high-grade work, and some of its investigations are conspicuously thorough and original. The Federal funds are generously supported by the State and the university, and in general a very liberal policy is followed toward the station.

MONTANA.

Montana Agricultural Experiment Station, Bozeman.

Department of the Montana College of Agriculture and Mechanic Arts.

F. B. LINFIELD, B. S. A., *Director.*

The Montana station steadily developed its work during the year. The changes on the staff were comparatively few and largely confined to the minor positions. The improvements in equipment were limited to the construction of secondary buildings to the extent of about \$4,000 in total expenditure. New greenhouses are shown in Plate VII, figure 2. The income of the station was increased by

\$2,500 in the maintenance fund and by \$4,000 in the appropriation for work in dry farming.

The Adams fund work of the station as reported showed progress in all the projects except the studies on cement and cementing materials, which were held in abeyance. The investigations on the oyster-shell scale had a bearing mainly on the life history of the insect, but work was also done on means for its control. The use of heavy oils for spraying proved very successful but too expensive for general use, while the cheaper oils gave fairly good results as insecticides, but caused some burning of foliage. Work on the parasites of the oyster-shell scale was continued and the results secured were prepared for publication. Studies were made of the native food plants and the life history of the sugar beet root louse, and incidentally methods for its control. Experiments involving clean culture and the elimination of weeds for the control of the insect failed, as it was found that the pest wintered over on the beet rootlets. It was observed in some fields that a fungus had completely destroyed the root lice, and work on this phase of the project was taken up. The cutworm investigations were continued to determine the identity of the species attacking various economic plants, and with this end in view breeding experiments with a number of species were carried on.

Experimental work relating to the physiological effect of arsenical compounds on vegetation was conducted in an orchard near the station. It was found that serious injury may be done to apple trees by the application of the so-called insoluble arsenicals. A particular study was made of the physiological effect of the poisons which seem to retard growth and check transpiration. Incidentally it was found that smelter-waste products produce similar effects.

The studies of tree canker, blackheart, anthracnose, and wood rot in orchard trees were carried forward, the principal investigations, however, being on the apple canker and the collar rot of apple trees. The collar rot was reported as due to a specific fungus which has been worked out, but for which means of control have not as yet been established.

The agronomical projects were held largely in abeyance during the period the agronomist was pursuing advanced work at Cornell University. In the project on correlation and inheritance, about 750 plants of pure-line grown Sixty-Day oats were studied, in addition to similar plants of Dawson Golden Chaff wheat. The projects relating to methods for conserving light rainfalls and conditions favoring the development and control of nitrates in the soil were combined and the work was carried on in cooperation with the bacteriologist and the chemist.

In the egg-hatching investigations changes in temperature during incubation were determined by means of electric thermometers, and

analyses were made of eggs at different periods of artificial and natural incubation to ascertain the changes in lime and phosphoric-acid content. Under the conditions of the experiment temperature appeared to be the controlling factor for good hatches of strong chicks. Ventilation did not appear very essential, but at the high altitude of the station moisture proved to be a very important factor.

The investigation on the effect of various factors on the wool and the form of the sheep was essentially a study of the effect of dipping, feed, and breed of sheep. The data obtained from many samples of wool were compiled and a basis was established for the interpretation of the results obtained. Formulas were worked out on the diameter and strength of fiber for comparing different samples.

The station had considerable work in progress under Hatch, State, and other funds. In the department of entomology considerable attention was paid to the subject of tick control in relation to the Rocky Mountain fever. This work, carried on in cooperation with this department, was partly reported upon in Bulletin 85 of the station. Studies of other species of ticks and methods of control were included in the investigation, and notes were also taken on a considerable number of insect pests, some of which have been quite troublesome in the State. Attention was further given to bee keeping, with the hope of establishing the industry in Montana. By State law the entomologist of the station was made State entomologist, with duties relating to the enforcement of a State insecticide and fungicide law.

Among other work, the bacteriologist pursued studies on the apple or pear blight and on a serious potato disease which has had the effect of largely reducing the yield in the eastern part of the State. In this work it was found that bees were an important factor in distributing apple or pear blight and that certain varieties of apples were more susceptible to the disease than others.

In animal husbandry, feeding experiments were conducted with pigs, sheep, horses, cattle, and other live stock. The effect of the character of food on breeding sows and their pigs was observed, and experiments on inbreeding were begun to determine the constitutional differences produced in pigs by this method. In a feeding test with dairy cattle, clover silage and corn silage were compared with clover hay. In the feeding of beef cattle an attempt was made to determine the cost of beef production under farm conditions.

The work of the horticulturist consisted principally of variety and cultural work with small fruits, tree fruits, vegetables, and ornamentals. The effect of pruning to hasten ripening of tomatoes, squashes, and cucumbers was studied, as each of these crops normally does not ripen its fruit at the elevation of the station. At the horticultural substation in the Bitter Root Valley (Pl. VIII, fig. 1), varieties of apples,

cherries, and pears were tested, and culture experiments on 5 acres of apples to improve fertility were begun.

The department of agronomy conducted tests with 42 varieties of wheat, 43 of oats, 49 of barley, and 20 of peas. Experiments were begun for the purpose of developing varieties of winter oats and barley for the dry farm region (Pl. VIII, fig. 2.) Dates and rates of seeding for wheat, oats, barley, and peas were determined, and studies of grain mixtures for forage and grain production were made. The work of this department also included a study of the cost of pumping water under different conditions with different pumps, fuel, height of lift, kinds of engines, and other factors affecting the operation.

The chemical department gave attention principally to a study of the infertile soils of Montana, this work being carried on cooperatively with the department of agronomy. Attempts were made to determine the cause of infertility, and to establish methods of treating the soil for its restoration. This department cooperated further with the department of animal husbandry to determine the nutritive value of clover cut at different stages of growth in connection with feeding experiments with this crop.

The publications received from this station during the year were as follows: Bulletins 82, Eighth Annual Report of the State Entomologist, 1910; 83, Dry Farming Investigations in Montana; 84, Grain Investigations with Wheat, Oats, and Barley; 85, Tick Control in Relation to the Rocky Mountain Spotted Fever; 86, The Use of Soap to Retard the Settling of Certain Arsenicals; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	55,663.45
Farm products.....	6,845.33
Total.....	92,508.78

The Montana station has made good progress in placing its equipment on an efficient working basis, and in dealing with the many agricultural problems which arise in a rapidly developing State of large area with diversified conditions.

NEBRASKA.

Agricultural Experiment Station of Nebraska, Lincoln.

Department of the University of Nebraska.

E. A. BURNETT, B. S., *Director.*

The Nebraska station made general progress during the past year. The changes on the station staff included the appointment of R. K. Bliss as animal husbandman to succeed H. R. Smith, who entered

upon similar work at the Minnesota station, and the resignation of E. G. Montgomery, the agronomist, who was called to the New York Cornell station. T. A. Kiesselbach, assistant in agronomy at the station, was placed in charge of experimental agronomy, and J. A. Ratcliff was appointed assistant. R. F. Howard, assistant in horticulture, resigned and J. R. Cooper was named as his successor. A dairy shed for use in experimental and other work was erected at the station at a cost of \$2,000. During the year a quarter section of irrigated land was acquired at Culbertson for the new branch station authorized by the State legislature, and a dwelling and machine shed were constructed at a cost of \$3,000 as a part of the equipment. Dwelling houses were built at the North Platte and Scotts Bluff substations at a cost of \$8,000 and \$1,400, respectively.

Work under the Adams fund was pursued along a number of well-established lines. The potato-disease investigation was largely confined to the study of the life history and the control of the *Fusarium* dry rot which affects potatoes only in storage. A bulletin was prepared giving the life history, morphology, and pathology of the organism, which was found to be new and undescribed and was named *Fusarium tuberivorum*. Preliminary investigations were made on a new potato disease appearing mainly in the vicinity of the Scotts Bluff substation, and some work was also done on stem-end rot.

The studies on the soils of the transition region were carried forward, and a progress report on the work dealing with the composition of the loess soils of the transition region was presented at the Eighth International Congress of Applied Chemistry. Another phase of the investigation, the relation of the available to the free water of the soil, was completed and a report prepared. From the results secured it was concluded that the soil water available to plants for growth and for maintenance of life is approximately equal to the free water in the soil volume occupied or to be occupied by the plant roots.

The project on the effect of soil moisture on winter injury of fruit trees was held back during the year by the absence of the horticulturist while pursuing work at Bussey Institution. The work carried forward had a bearing mainly on freezing temperatures in their relation to the movement of sap and on the effect of extra storage of water and bark protection on hardiness in orchard and small fruits.

The study of heredity in plants was conducted principally with beans and corn, the aim being to determine whether such qualities as size and similar quantitative characters can be analyzed in the Mendelian sense. Work was also done on the inheritance and development of pigments in corn and in bean pods and on the influence of light in this connection.

The effect of thickness of stand on cereal plants was studied with corn and small grains, and part of the work was reported in Bulletin

127. With corn, studies were made of the seed from thick and from thin planting and of the influence of crossbreeding and inbreeding on the productivity of the corn plant and its size and vigor. Planting corn thick enough to introduce competition produced higher yielding seed corn which was thought due probably to the elimination of the less vigorous strains. With small grains the percentage of plants surviving until harvest gradually decreased as the rate of planting increased. Large, plump seeds were found to survive better in competition than small, shrunken seed. The method of thick seeding of small grain employed allowed the natural elimination of one-half the plants each year without affecting the yield. The freezing out of the winter wheat in these experiments interfered to some extent with the work.

The study of the degree of close breeding in maize was continued with 110 inbred strains to determine how many types can be developed in one variety of corn. Many quite distinct types have been secured. A study was also made of these different types to find out those giving best results when bred together.

The investigation of the relation between the leaf area of the corn plant and the water used in growth was continued as before. It was found that the water transpired did not bear a direct relation to the fertility of the soil, but that adding fertility to a poor soil greatly reduced the amount of water required to produce a pound of dry matter, while adding fertility to a rich soil had very little effect. Transpiration appeared more closely related to leaf area than to the dry matter produced. Corn grown in a greenhouse kept artificially humid required much less water to produce a pound of dry matter than corn grown in a greenhouse with natural humidity.

The pine-tip moth project was brought near to completion during the year. The life history was worked out and the enemies of the insect were studied. The increase of parasites attacking the pest reduced the injury caused by it during the season.

The investigations on the relation of animal conformation and quality to gaining capacity was continued with 32 calves and 32 steers, which were slaughtered at the close of the experiment. In comparing light, heavy, and medium rations of silage and medium and heavy grain rations, it was found more profitable to finish cattle with a liberal feed of grain and correspondingly smaller quantities of silage. In comparing types of cattle, depth of body and size of middle girth seemed to be associated with large gains.

Under Hatch and State funds, a study of wild and some cultivated grasses of Nebraska, including their classification, was completed and reported upon.

The dairyman, who entered upon his position in October, 1911, made preparations in anticipation of work to be inaugurated. A

bulletin was published during the year on the milk and butter producing capacity of the best and poorest cows in 17 herds, and on the profits derived from different herds and individuals.

In horticulture, the orchard plat work on different methods of tillage in progress for some time was continued, together with cross-breeding experiments with the apple. Attention was also given to hill selection of potatoes and to degeneration in strains and varieties. The use of straw mulch in keeping down the temperature was given trial as a means of maintaining the yield and the strength of the seed tubers.

The agronomist carried on extensive work with corn and wheat. Reports were made of wheat-breeding experiments in Bulletin 125 and on studies of native seed corn in Bulletin 126 of the station. Numerous strains of wheat were grown in nursery rows and used in a study of the experimental error. A comparison was made of the five poorest and the five best strains, each being repeated 50 times in the nursery and eight times in the field. The better strains showed an average increase for four years of 5 bushels per acre over the original wheat. Three of the strains have been sent out to farmers for two years for comparison with their own wheat. The mere variety testing was reduced to a minimum. Considerable corn-breeding work was in progress to improve quality and yield by means of ear-to-row selection and other methods. Other work with corn included a study of the accuracy of the methods used in testing yield, the effect of removing suckers and tassels, selection based on the leaves, and other similar lines. Culture and inoculation experiments with soy beans were also in progress.

With a State fund of about \$2,500, the entomological department conducted some field work and breeding work to follow up the insects particularly injurious during the year. Special attention was given to alfalfa insects.

The veterinarian was mainly occupied with hog-cholera work. A new serum plant was completed by January 1, 1912, and the demand for serum greatly increased during the year. A study was made of the effect on the progeny of treating sows with large doses of serum, and observations were made on the time of immunizing young pigs. It was found that hyperimmunization rendered the offspring immune to some extent, but the action did not appear uniform.

In animal husbandry, feeding experiments were conducted with steers to test the value of silage.

The publications received from this station during the year were as follows: Bulletins 121, Growing Hogs in Nebraska; 122, Cost of Growing Crops in Nebraska; 123, Fattening Hogs in Nebraska; 125, Wheat Breeding Experiments; 126, Native Seed Corn; 127, Competition in Cereals; 128, Studies in Water Requirements of Corn; 129,

Results of the Douglas County Cow Testing Association; Extension Bulletin 3, The Germination Test for Seed Corn; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation, amount used for substations.....	40,535.60
Miscellaneous, including balance from previous year.....	51,003.21
 Total.....	 121,538.81

The Nebraska station, on the whole, is in a very satisfactory condition. It has in hand a good amount of investigation of importance to science as well as to practical agriculture. The desire for local stations under its direction is an indication of the popularity of the station work in the State.

NEVADA.

Nevada Agricultural Experiment Station, Reno.

Department of Nevada State University.

G. H. TRUE, B. S., *Director.*

The principal changes at the Nevada station during the year were those occurring on the station staff. On April 3, 1912, J. E. Stubbs relinquished the directorship to devote more time to his duties as president of the university, and G. H. True, in charge of the department of agriculture and animal husbandry, was appointed and entered upon the position as his successor. Other changes included the resignation on January 1, 1912, of C. S. Knight, agronomist, and the appointment of C. L. Brown to take up work on the potato eelworm. The live stock belonging to the experiment station was transferred to the college of agriculture of the university, an appropriation of \$5,000 having been made for the purpose. In the station work with live stock the college stock will be used, the station bearing the expense of the work during the experiments.

Progress on the Adams fund work was reported. The meteorological and climatological investigations were carried on mainly with reference to highland and lowland weather conditions, to determine the cause of temperature differences as associated with topography and to the relation of mountains and forests to the conservation of snow. Meteorological data were recorded by instruments installed on Mount Rose and the records obtained at that elevation were supplemented by observations made at about 20 additional points. Much of the work on snow was done near Lake Tahoe, where studies were made of the effect of different types of trees, soils, exposure, and other factors on the melting of the snow. The data secured are considered important.

In the study of the genus *Trifolium*, clover plants representing different species were grown in the greenhouse in winter and out of doors in summer, and increase plats were maintained at the station farm. Some of the native species gave promising results. A study of the fertilization of 34 species grown in the greenhouse was made and native and European species under the conditions were compared. Plants of the group called *variegatum* produced seed of high germinative quality and spread rapidly under natural conditions.

In pursuing work on a fatal disease among horses, which has been diagnosed as equine anemia, inoculation experiments with five horses secured remote from infested districts to avoid the possibility of immunity in the animals, were carried on through the year.

Progress was reported on the project relating to parasitism of the codling moth and during the year Bulletin 78, giving the results of studies on some of the biological features of the investigation, was published. Experiments were in progress on secondary and tertiary parasitism as produced in the laboratory. By means of special devices, it was found possible to carry different species under investigation through almost indefinite generations. Facts relating to the fertilization and growth of parasites were developed and methods of photographing parasites were perfected.

A considerable amount of work was supported by Hatch and other funds. In cooperation with the irrigation investigations of this office, work was conducted on a hydrographic survey of the Humboldt River Basin, and a study was made of irrigation as applied to the station farm. In connection with the survey, the inflow and outflow of water in the valley was determined at one point, and the evaporation from the river surface was measured at two additional points. At the station an attempt was made to determine the amount of water required to produce a pound of dry matter in alfalfa, wheat, oats, and other crops. With wheat and oats irrigation experiments were also in progress to study the relation of watering to the period of heading.

The ordinary Arabian alfalfa did not prove hardy in Reno, and was found quite subject to disease in the southern part of the State. Attention was given to the subject of cover crops and tests were made with Shaftal clover for this purpose. The reputed poisonous properties of various lupines were investigated. The effect of irrigating orchards was studied, comparisons being made with a check plat unirrigated for the last five years. In the spring of 1912 work on frost control was carried on. Nurseries were established for growing forest and fruit trees, and the possibility of growing poplars in the nursery was demonstrated. The work on the Lincoln County experiment farm during the past year was also largely horticultural.

The veterinarian tested the Dorset-Niles hog-cholera serum and studied its curative and preventive effects. Observations were also made on a number of obscure diseases of horses, cattle, chickens, and other animals. The work of the hygienic laboratory, which was established by the State, was continued.

In working out methods of controlling European elm-scale, the department of entomology found that spraying the trees with water under pressure from 60 to 80 pounds per square inch was very effective. Progress was reported on the study of alfalfa cutworms, advance in knowledge of the life history and in the control of the pests being made.

The plant-disease work of the station included a study of a poplar disease in connection with which a fungus was usually found present. Attention was also given to Fusarium disease of tomatoes, squashes, and other garden plants. The investigation of the eelworms on potatoes was undertaken to determine the methods of attack and the relation of the parasites to soils, irrigation, and varieties.

In the department of agriculture and animal husbandry the crop work was largely confined to testing varieties and experiments in irrigation. The study of the relation of the time of applying water to yield and composition of wheat and alfalfa and the duty of water for corn, beets, and alfalfa was continued from previous years. Work on the improvement of wheat, barley, and rye by means of selection was also carried on. At the State dry farm at Elko work was done on testing various crops and on methods of handling them. Winter grains were added to the list within the past year. The animal-husbandry work consisted in the main of testing alfalfa silage for feeding stock cattle and of determining the cost of milk and butter production.

The publications received from this station during the year were as follows: Bulletins 73½, Annual Report of the Board of Control, the Director, and the Members of the Station Staff, 1910; 78, Concerning the Relation of Food to Reproductive Activity and Longevity in Certain Hymenopterous Parasites; 79, The Avoidance and Prevention of Frost in the Fruit Belts of Nevada; Circulars 12, Saccharin in Food, and 13, Anthrax.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$14,116.76
United States appropriation, Adams Act.....	13,964.82
Balance from United States appropriation, Adams fund.....	1,035.18
Balance from United States appropriation, Hatch fund.....	883.24
State appropriation.....	5,000.00
Farm products, including balance from previous year.....	8,936.24
Total.....	43,936.24

The work of the Nevada station is making satisfactory progress along many lines. The greater differentiation between college and

station work and the strengthening of the station staff by an increase in membership will doubtless be of value to the station as well as to the people of the State.

NEW HAMPSHIRE.

New Hampshire College Agricultural Experiment Station, *Durham*.

Department of New Hampshire College of Agriculture and Mechanic Arts.

J. C. KENDALL, B. S., *Director*.

There were practically no changes on the staff of the New Hampshire station during the period covered by this report, but since the close of the fiscal year, in addition to a few changes in the minor positions, J. M. Jones succeeded T. R. Arkell as animal husbandman, J. H. Gourley was appointed horticulturist to succeed B. S. Pickett, and O. R. Butler was appointed successor to C. Brooks as botanist. The principal addition to equipment during the year was the completion of a college and station horse barn at a cost of about \$6,000. Minor improvements in office and laboratory facilities were also made, and the business management and administration of the station was reorganized.

There was uninterrupted progress in several of the Adams fund projects during the year. The results of the work on apple diseases were published in Bulletins 157 and 161 of the station and were also discussed in part in an article appearing elsewhere.¹ The work on the point rot of tomatoes was about completed during the past season.

The plant-breeding projects, including studies of heredity and correlation of vegetables, principally squashes, cucumbers, and tomatoes, and work in carnation breeding, were also nearly completed and the results secured were prepared for publication.

The study of the causes and means of control of fruit-bud formation, in charge of the botanist and horticulturist, was continued almost exclusively by the horticulturist in an orchard containing about 300 trees. It was observed in connection with this work that the rate of wood growth in plats cultivated every other year was approximately double that of plats not cultivated, and in plats cultivated every year the rate of growth was about double that of plats cultivated every other year.

Some preliminary work was done on the control of root maggots, especially studies of the basic rules for the use of insecticides beyond the surface of the ground that will kill root maggots, including such points as the extent and rate of diffusion of poisonous gases, the effective zone of poisonous liquids, the effects of various chemicals on the different classes of animal and vegetable life, and other closely allied questions.

¹ *Phytopathology*, 2 (1912), No. 2, p. 63.

The investigations on the apple maggot were nearing completion. The results obtained included the accurate life history and habits of the species and the best means of its control, together with data on the extent of infestation by the insect in the State, the susceptibility of different varieties of apples and the determination of affected fruit in storage as compared with unaffected fruit.

The sheep-breeding project continued to be the largest piece of Adams fund work. As in the previous year, this investigation was conducted with the aid and cooperation of C. B. Davenport, of the Carnegie Station for Experimental Evolution. A report on the study of the inheritance of horns in sheep was published as Bulletin 160 of the station and in articles in *Science*.¹ Data were also gathered on the inheritance of other characters in sheep and these results are to be published shortly.

In addition to the Adams fund projects, the station carried on variety and fertilizer tests with corn, and experiments with alfalfa and in clover plant selection and pasture improvement. Work in timothy breeding was also undertaken during the year. Corn-breeding experiments have resulted in the development of a promising earlier strain of yellow dent which matured the past season in 110 days. Experiments were begun with flint corn with a view to shortening the growing season and to increasing the yields of some of the best strains. In fertilizer experiments on heavy clay grass lands the largest yields were obtained with an application of 400 pounds per acre of sodium nitrate.

The animal husbandry department continued sheep-feeding experiments with different rations for the comparison of clover and native hay and with root crops and dry feeds. Trials of tobacco in the feed to eradicate intestinal parasites in sheep were continued with apparently good effects in restraining the ravages of the stomach worm, but no definite conclusions were drawn from the work at this stage.

The entomological work included the investigation of a serious outbreak of chinch bugs in the State and the rather sudden appearance of an obnoxious beetle reported from the White Mountains. Studies were also made of the life history and control of black flies. The successful control of these insects was demonstrated on an area of 8 square miles under treatment for two successive seasons. New phases were discovered in the life history of the pest which do not have a direct bearing on the matter of treatment for its control, but concerned rather the program or schedule of treatment.

The horticulturist in an orchard of 201 trees continued studies of the growth, hardiness, and productiveness of 24 varieties of plums, including the 4 most important groups. In addition to determining the more promising varieties in the different groups, it was

¹ *Science*, 35 (1912), Nos. 897 and 911.

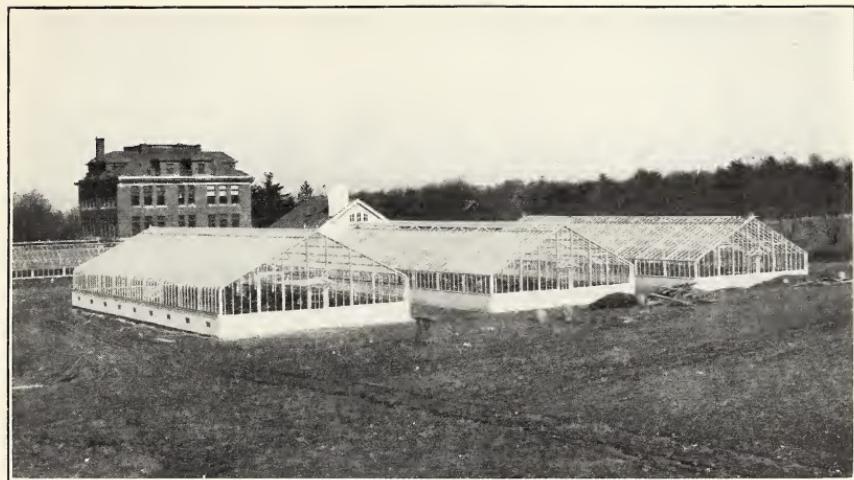
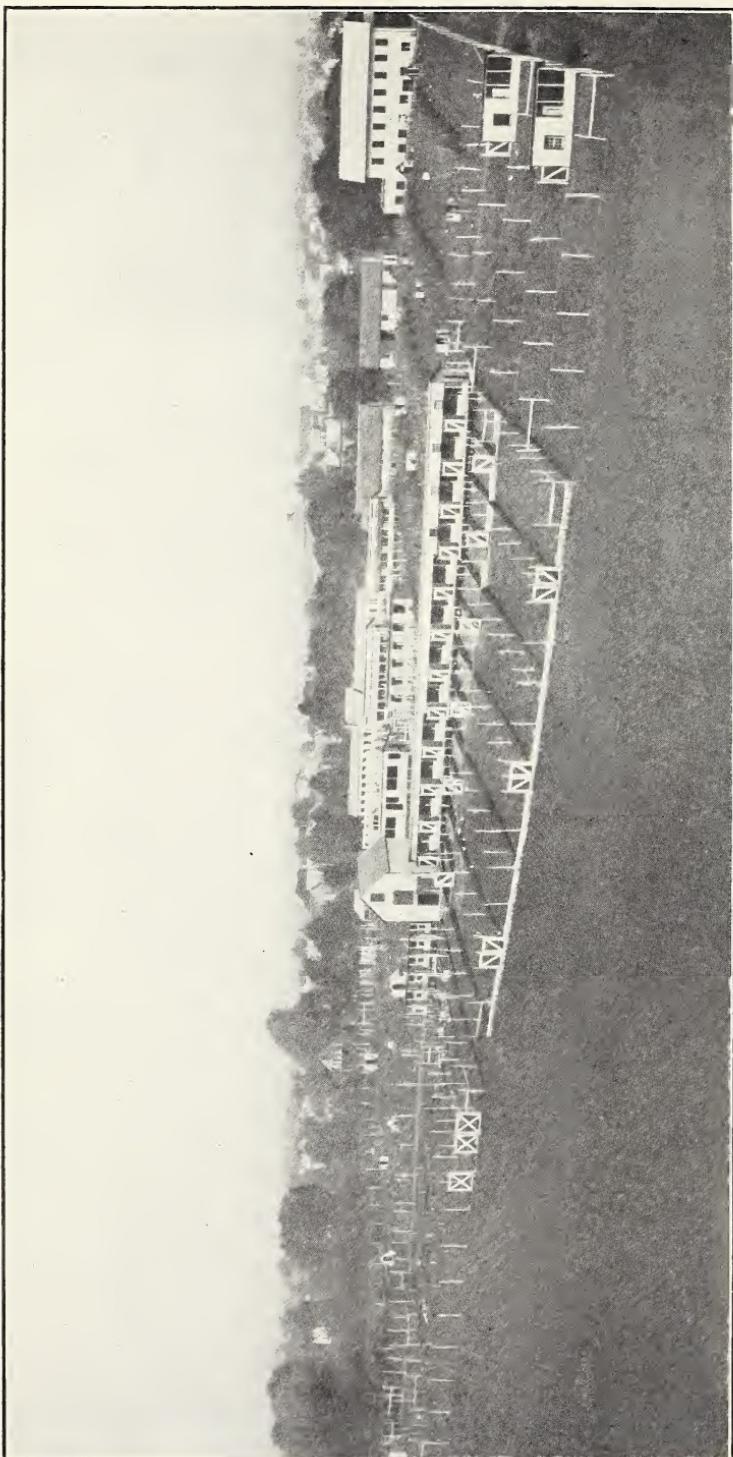


FIG. 1.—GREENHOUSE FOR FLORICULTURAL INVESTIGATIONS, NEW JERSEY STATION.



FIG. 2.—POULTRY ADMINISTRATION BUILDING, NEW JERSEY STATION.



POULTRY PLANT, NEW JERSEY STATION.

observed that the variety Burbank is self-sterile and must be grown near a free-flowering variety to produce satisfactory crops. A test of 35 varieties of apples was conducted in an orchard containing 375 trees. A number of varieties of currants, gooseberries, blackberries, and raspberries was studied with regard to their hardiness, productiveness, and quality. The results with fertilizer experiments with carnations were published during the year in Bulletin 159 of the station. The use of bone meal gave the best general results, being more satisfactory than applications of either muriate of potash or nitrate of soda. Hen manure when used in excess had a tendency to force the plants quickly into a weak growth and to impair the keeping qualities of the flowers.

Cooperative experiments on the effect of lime were conducted in 25 localities of the State, representing different types of soil and climatic conditions. Similar cooperative experiments were carried on with hay and corn and in orchard planting and management. Dynamite was used in setting out orchard trees for the purpose of noting and demonstrating the effects of the practice.

The publications received from this station during the year were as follows: Bulletins 153, Fruit Bud Formation; 154, The Feeding Stuffs Inspection for 1911; 155, Inspection of Fertilizers for 1911; 156, Results of Seed Tests for 1911; and Circular 14, The Apple Maggot or "Railroad Worm."

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products.....	464.83
Miscellaneous, including balance from previous year.....	4,586.31
Total.....	35,051.14

The New Hampshire station is progressive in matters of organization, management, and pursuit of work. Its different lines of activity are followed in a systematic manner, and the principal agricultural problems of the State are receiving attention.

NEW JERSEY.

New Jersey State Agricultural Experiment Station, New Brunswick.

At Rutgers College.

J. G. LIPMAN, Ph. D., *Director.*

New Jersey Agricultural College Experiment Station, New Brunswick.

Department of Rutgers College.

J. G. LIPMAN, Ph. D., *Director.*

The principal developments at the New Jersey stations during the past year included the establishment of a department of plant pathology and progress in the newer features of poultry husbandry, floriculture,

ture, and animal husbandry. (Pl. IX.) Dr. J. B. Smith, in charge of the department of entomology since 1889, died March 13, 1912, and was succeeded since the close of the fiscal year by T. J. Headlee, of the Kansas station. Among the State appropriations not heretofore mentioned is the sum of \$12,000 for buildings for dairy husbandry work, and of \$100,000 for the construction of an agricultural building to be used partly for experiment station work and partly for short course instruction. The fertilizer, feeding stuffs, and insecticide laws were revised at the last session of the State legislature, and a seed law was passed providing for the collection and examination of samples of agricultural seeds sold in New Jersey.

As in previous years, the Adams fund work of the station consisted of studies in soil chemistry and bacteriology and plant breeding. A study was made of the availability of fertilizers, with results showing a wide range in availability of nitrogenous materials of animal and vegetable origin and the efficiency of the bacteriological method employed in bringing out these differences. It was found that sodium nitrate had a tendency to stimulate the decomposition of inert nitrogenous substances, and that lime-soluble phosphates, various stimulants, and other materials may favor or depress ammonification in soils. Relatively small amounts of dextrose and other sugars had a stimulating effect on the decomposition processes in the soil, while larger amounts depressed ammonia accumulation. The depressing effect of various carbohydrates in this connection appeared more or less directly related to their chemical composition. In addition, the possible influence of protozoa on ammonification and the conditions affecting the availability of nitrogen compounds in vegetation experiments were studied.

In plant breeding, extensive studies were continued with tomatoes and bulletins were issued during the year on the F_1 heredity of size, shape, and number of tomato leaves in seedlings and mature plants. The work with the seed cavities of a related plant included a count of upward of 200,000 fruits, and the results showed a decided increase of the seed cavities associated with selection to that end. Other work in plant breeding included the growing of 13 isolated blocks of corn to secure material for the study of the inheritance of different factors, of 100 commercial varieties of peppers for the comprehensive study of the behavior of parents upon offspring in both the pure stocks and the crosses already obtained between them, and the growing of eggplants and the various classes of beans for similar work. A part of the breeding grounds was devoted to the study of hybrids between okras and an ornamental species.

Progress was also recorded in the different lines of work supported by Hatch funds. As in previous years, the peach investigations formed the principal line of work in the horticultural department. All of the fruit in the experimental orchards at Vineland and Highbridge,

containing in all about 2,500 trees, was harvested and marketed under the supervision of the department and afforded opportunity to study problems of transportation and distribution as well as methods of packing. Time was also devoted to the study of peach diseases and their distribution by means of nursery stock. The investigations with carnations and roses were extended and fertilizer experiments with standard and dwarf apples were continued.

In the poultry husbandry department, considerable time was given to the planning and laying out of the new station poultry plant and in erecting the buildings. (Pl. X.) The experimental work, necessarily of a preliminary nature, included studies of the need of moisture in artificial incubation and the benefits to be derived from supplying it in the right amount and at the right time, the value of uniform temperature conditions under brooder hovers, the use of sprouted oats as a source of succulent green feed for winter feeding, and a detailed study of winter egg production, together with observations on the amount and the cost of food consumed. Experiments were also begun on the hatching and rearing of chicks with special reference to the early selection of the chicks with regard to the vigor and vitality of the individual. Some of the results secured bearing mainly on profitable egg production were published during the year in bulletin form.

The biologist continued researches in oyster propagation under State appropriation. A law recently enacted authorizes a considerable extension of this work under an oyster observation service in conjunction with the State bureau of shell fisheries. The work of the new floating laboratory stationed at Barnegat during the summer, owing to the failure of a catch of oyster seed at that point, was limited to a study of the spawning of the adults and of the habits of the fry. Some time was also devoted to giving directions for conducting the observations required in the new service and to explaining the methods worked out by the biologist for ascertaining the number of oyster fry present in the water on oyster grounds.

The work in the entomological department was in general conducted along the same lines as in previous years and included studies of the plum curculio, together with root maggots and similar pests. Attention was also given to the use of insecticides in the greenhouse and the nursery and the work on mosquito control in progress for several years and supported by the State was continued. The importance of this control work, coupled with the cooperative efforts of the localities immediately benefited, was emphasized during the season from all points of view. Apiary inspection work was organized as provided for by State law.

The work of the animal husbandry department was interrupted by the fire of July 11, 1911, and only general results were reported. The activities of the department as planned included an increase in

the area of corn and alfalfa in connection with feeding tests with dairy cows. Although the yields of these crops were shortened by drought, ensilage and alfalfa proved the most economical base for the dairy ration. The growing of cover crops was continued with rye or wheat and vetch and soy beans were grown after oats and peas in a rotation test. Some attention was given to serum treatment and other preventive measures against hog cholera. An experiment was in progress to ascertain the comparative value of tankage and alfalfa as a source of protein to supplement corn meal and wheat middlings for the purpose of determining a suitable home-grown feed for raising and fattening swine. The use of ground oats and peas together with soy beans in a ration for hogs gave promising results. The destruction of the dairy barn precluded reliable work on the cost of producing milk and on the relative value of oat and pea silage as compared with green forage or summer corn silage.

The publications received from this station during the year were as follows: Bulletins 237, Concentrated Feeding Stuffs; 238, The F_1 Heredity of Size, Shape, and Number in Tomato Leaves—I, Seedlings; 239, The F_1 Heredity of Size, Shape, and Number in Tomato Leaves—II, Mature Plants; 240, Analyses and Valuations of Commercial Fertilizers—Analyses of Fertilizer Supplies, Home Mixtures, and Special Compounds; 241, Analyses and Valuations of Commercial Fertilizers and Ground Bone; and 242, The F_1 Heredity of Size, Shape, and Number in Tomato Fruits.

The income of the station during the past fiscal year was as follows:

State Station: State appropriation (fiscal year ended Oct. 31, 1912).....	\$94,041.96
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College Station:	
United States appropriation, Hatch Act.....	15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products.....	673.89
<hr/>	
Total.....	124,715.85

The affairs of the New Jersey stations are generally in good condition, and an effort to strengthen the work and to enlarge its scope is in evidence. The State appropriations for buildings will give the station as well as the college much better facilities.

NEW MEXICO.

Agricultural Experiment Station of New Mexico, State College.

Department of New Mexico College of Agriculture and Mechanic Arts.

LUTHER FOSTER, M. S. A., *Director.*

Changes in the staff of the New Mexico station were again numerous during the year, among the more important being the advancement of H. S. Hammond to the headship of the department of botany in

succession to E. O. Wooton, and the resignation of J. H. Squires in charge of the department of agronomy, who was succeeded by E. P. Humbert of the Maine station. General improvement was made in the station equipment, particularly for conducting the investigations in nutrition and irrigation.

The Adams fund projects of the station were continued along the lines previously indicated. The study of the relations of soil, water, and crop in irrigation was interfered with by untoward weather conditions, which made it necessary to reconstruct most of the plats on which the experiments were in progress and to begin part of the work anew. A part of the distribution system on the experiment area was changed by the installation of corrugated iron flumes to increase efficiency in handling the water.

In connection with the investigations on the flow of water through submerged orifices, a reenforced concrete reservoir and a 6-inch vertical pump with a 22-horsepower engine were installed for use in supplying water for the experiments. Considerable time was spent in calibrating apparatus and in checking it by measurements of the water in the reservoir. By means of the new and more efficient installation it was possible to check the measurements more readily and accurately than theretofore, as not only the rate of pumping the water but the capacity of the reservoir also was known. Progress was made in working out the formula for calculating the actual flow, which involved making a table of contraction constants for each effective head and for each opening of the orifice.

A new project on cereal breeding was entered upon. Special apparatus for thrashing and cleaning the harvested material was provided. This work included a study of mass selection as compared with pure-line selection.

The grape crown-gall investigations were completed and the results prepared for publication. The study of the failure of potatoes to set tubers satisfactorily was continued in the field and in the greenhouse, mainly with reference to the effect of temperature and humidity conditions. The artificial raising of humidity did not increase tuber formation. The plant-breeding work with the Mexican chili progressed quite satisfactorily, but trouble was again experienced with a severe attack of blight, causing the death of many plants and in some instances nearly destroying whole strains in the experiment. A beneficial effect of the attack seemed to be indicated by the almost perfect resistance of some plants to the disease. Work on the identification and life history of the organism causing this disease was taken up toward the close of the year, and experiments were made with reference to its transmission through the seed. The studies of the codling moth were actively pursued and further data regarding the life history of the pest were obtained. The results suggested more

efficient methods for the control of the different broods which were tested cooperatively in several orchards near the station.

The investigation on the nutritive effect of important feeds for the production of beef with range steers was continued as originally outlined. Calves and 3-year-old steers were used in 120-day feeding experiments with alfalfa hay. During the feeding period the digestibility of the ration was determined, and after the close of the test the steers were slaughtered to determine the percentage of dressed carcass in each case. The carcasses were also judged as to quality of beef, and sample cuts were analyzed for moisture, nitrogen, and fat.

Under the Hatch fund the work in agronomy consisted of variety testing of wheat, oats, barley, rye, maize, and, to some extent, alfalfa, the work being in continuation of that previously begun. Rotation experiments were continued and attention was given to different phases of alfalfa growing, including tests of seeding, amount of seed per acre, cultural methods, and similar work. The results seem to indicate that seeding the latter part of January or the first of February gave the best result. In addition, studies were begun to determine the cost of growing the different crops cultivated at the station.

The horticulturist carried on a large amount of work, including culture experiments with Denia onion on which a bulletin was issued, and breeding experiments begun for the improvement of different strains. Experiments were also conducted in celery growing and blanching, planting of cabbage and beans on different dates, and cassava culture. Orchard work of various kinds with peaches, pears, apples, and grapes was in progress and experiments on smudging orchards for the prevention of frost injury were undertaken. The peaches at the station were found to withstand a temperature as low as 26° F., and under the conditions the danger period was between 5 and 6 a. m. In addition to this work tests were made of grafting apple on pear stock as a means of combating the root aphid.

In animal husbandry the work consisted principally of a test of different grains for feeding dairy cows and of feeding experiments with different breeds of pigs to determine the feeding value of soaked and ground small grains, of wheat and barley, and of skimmed milk added to a grain ration. The comparison of the lard and bacon type of hogs for local conditions was continued and a study was made of the use of a concentrated ration in this connection.

The botanist endeavored to ascertain the extent within the State and the economic importance of pear blight, chlorosis, cotton root rot, tomato wilt, bean rust, early blight of the potato, crown gall of the grape, alfalfa-leaf spot, cereal rusts and smuts, and various mildews. Attention was also given to an ergot of foxtail which appeared in the vicinity.

The entomological work of the year included systematic work and various investigations on the life history and habits of injurious and

beneficial insects. Among the insects studied were the grape leaf hopper; onion thrip; alfalfa thrip; a new beetle pest of cantaloups; a fly, three lepidopterous, and three coleopterous pests infecting cacti; parasites of various larvæ of Lepidoptera; a Sciarid and aphid-infesting loco; cornworm; a Bostrychid borer in mesquite; mosquitoes; meal moths and beetles; and the beneficial ground beetles and coccinellids.

The chemist, in cooperation with the United States Geological Survey, studied the composition of the soils and waters of the Tularosa Basin. This study included the complete analyses of 11 streams, 32 springs, and surface bodies of water, together with the analyses of from 250 to 300 samples from wells located in different parts of the basin. Seventy-three samples of soil were examined to determine the amount and character of the alkali, including the salts of lime, magnesia, and soda. In this work an effort was made to determine the combinations that exist between the acid and basic radicals that constitute the salts. A bulletin on the composition of some New Mexico waters, with a discussion of their fitness for irrigation and domestic purposes, was completed during the year.

The publications received from this station during the year were as follows: Bulletins 76, Peach Experiments, 1906-1910; 77, Tests of Centrifugal Pumps; 78, Cacti in New Mexico; 79, Alfalfa and Corn for Fattening Lambs; 80, A Study of the Carbohydrates in the Prickly Pear and its Fruits; 81, The Grasses and Grasslike Plants of New Mexico; 82, Growing Denia Onion Seed; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch act.....	\$15,000.00
United States appropriation, Adams act.....	15,000.00
Farm products.....	1,805.81
Fees.....	355.42
Balance from previous year.....	1,768.71
Total.....	33,929.94

The New Mexico station made substantial progress in its lines of experimentation, and so far as its funds permitted in the general improvement of its equipment. The station work is gradually becoming better systematized and is increasing in amount and in grade.

NEW YORK.

New York Agricultural Experiment Station, Geneva.

W. H. JORDAN, D. Sc., LL. D., Director.

The changes occurring in the staff of the station during the year were quite numerous, but were practically confined to the associate and assistant positions. The State appropriations remained the same as the year before, except that an allowance of \$3,000 was made to replace a carpenter shop destroyed by fire.

The Adams fund investigations, as in the previous year, were centered on the two projects then in force. Some of the results accumulated in the study of animal nutrition, with special reference to the physiological effect of certain phosphorus compounds, were published during the year in the station series of technical bulletins. The study of the metabolism of these compounds with milch cows was continued mainly to check previously reported results. In connection with a study of phytin and phosphoric acid esters of inosite, several new salts of phytic acid were described and two esters of inosite were obtained in pure form and analyzed. A study was also made of analytical methods, and those finally employed in this work were described and reported upon. This investigation further included a study of the organic phosphoric acid present in cottonseed meal. This constituent was found to be chemically very similar to phytic acid, but as not possessing any marked toxic properties.

The study of the changes occurring in the curing of cheese and brought about by the action of chemical and bacterial fermentations was continued but not completed. Some of the earlier results secured led to the study of the influence of chloroform in varying quantities upon bacteria and enzymes, to determine the agencies causing the breaking down of the cheese substance, and to an extensive technical study of cheese flora for the purpose of gaining knowledge of the specific action of the several classes of bacteria.

Numerous other lines of work were supported mainly by State funds. The bacteriological staff continued to devote much time to studies in connection with milk sanitation. Conclusions were reached regarding the influence of the milking machine on the germ content of the milk, and a bulletin on the subject was prepared. Attention was further given to the study of soil bacteria, especially as influenced by the application of lime and other substances. The investigation of the soft rots of cabbage, cauliflower, and turnip was carried on as in previous years in cooperation with the Vermont Experiment Station, and was confined mainly to a study of the various strains of organisms related to the soft rots and to an attempt at their classification.

The department of chemistry, as formerly, performed at the station the analysis of various materials inspected under the authority of the State commissioner of agriculture, including fertilizers, feeding stuffs, fungicides, and insecticides. Studies were made of the constitution of casein, of the effect of treating milk with carbon dioxid under pressure, and of the methods of investigating milk and its products, including a volumetric method for determining casein. Some new compounds of calcium with casein and paracasein, having important relations to the changes in milk when made into cheese, were determined.

In agronomy, alfalfa culture continued to receive attention, and various fungus diseases of the plant were given consideration, the most important among them being the leaf spot. It was observed that when moisture conditions are adequate, the leaf-spot fungus seldom develops to any great extent.

In dairy husbandry work, the keeping of records of the feeding and production of the station herd was continued and the influence upon profit of the individuality of the animals was studied. The results of studying for more than four years the effect of hand and machine milking were summarized during the year and prepared for publication. The study of the efficiency of goat's milk as food for infants and its cost of production was continued.

The horticultural department carried further its observations as to the character and value of old and new varieties of fruit, among them a number developed by the station in its breeding experiments. The results of five years of observation on standard dwarf trees in apple culture indicated that standard trees are preferable and the results of nine years' work, including the past year, on the merits of cultivating orchards and using cover crops as compared with keeping orchards in sod were in favor of cultivation with the use of cover crops. Other activities of this department included orchard fertilizer experiments, plant-breeding investigations with tomatoes and apples, and grafting tests with different stocks for American grapes.

The efforts of the entomological department involved a study of preventing the ravages of well-known insects and the investigation of the life history of new forms of injurious insect life, together with the development of methods for their control. Among the insects studied were the poplar and willow borer, leaf blister mite, grape leafhopper, ermine moth, pear thrips, turnip flea beetle, and the cabbage maggot. An effort was made to establish the average range of distribution of the pear thrips in the State. In studying the control of the grape leafhopper, an automatic sprayer for nicotin solutions was devised and proved most satisfactory.

The botanical department continued its field studies of plant diseases and plant nutrition. During the past year the 10-year experiments in spraying potatoes were concluded, the average results showing a material net profit from the annual spraying with Bordeaux mixture. A comparative test showed that neither lime-sulphur nor lead benzoate can be profitably substituted for Bordeaux mixture in spraying potatoes. Several new diseases were studied, particularly diseases of the raspberry and the currant, and samples of seed were inspected. A seed-inspection law was passed, making it incumbent upon the station to examine all samples of seeds sent in officially by the commissioner of agriculture.

The publications received from this station during the year were as follows: Bulletins 339, Is It Necessary to Fertilize an Apple Orchard (with popular edition); 340, Inspection of Feeding Stuffs; 341, Report of Analyses of Samples of Commercial Fertilizers Collected by the Commissioner of Agriculture during 1911; 342, Director's Report for 1911; 343, The Pear Thrips (with popular edition); 344, The Grape Leafhopper and Its Control (with popular edition); 345, Seed Tests Made at the Station during 1911 (with popular edition); 346, Influence of Crossing in Increasing the Yield of the Tomato (with popular edition); 347, A Comparative Test of Lime-sulphur, Lead Benzoate, and Bordeaux Mixture for Spraying Potatoes (with popular edition); 348, Analyses of Materials Sold as Insecticides and Fungicides; Technical Bulletins 18, A Contribution to the Life History, Parasitism, and Biology of *Botryosphaeria ribis*; 19, Phytin and Phosphoric Acid Esters of Inositol; Circulars 13, Pruning Fruit Trees; 14, Small Fruits—Management and Varieties; 15, The Peach in New York; 16, Pruning and Training the Grape; 17, Grafting and Propagating Plants; 18, Pedigreed Nursery Stock; 19, Grape Culture; Twenty-ninth Annual Report, 1910; and the Annual Report for 1910, pt. 2, The Plums of New York.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$1,500.00
United States appropriation, Adams Act.....	1,500.00
State appropriation, including balance from previous year.....	122,218.02
Total.....	125,218.02

The New York State station is in a very prosperous condition, and is receiving in even a larger measure than before the support of the farmers in the State.

Cornell University Agricultural Experiment Station, Ithaca.

Department of New York State College of Agriculture at Cornell University.

L. H. BAILEY, M. S., LL. D., *Director.*

The Cornell station continued to pursue actively the numerous lines of work in hand. The changes on the station staff included a number of promotions and numerous appointments, mainly to subordinate positions. B. M. Duggar, plant physiologist, resigned during the year to accept the professorship of botany in Washington University. John Craig, horticulturist at the station since 1903, died August 12, 1912. Since the close of the fiscal year H. J. Webber, in charge of the department of plant breeding, has accepted a position with the University of California as professor of plant breeding, director of the Citrus substation at Riverside, and dean of the proposed school of tropical agriculture.

The Adams fund work of the station was distributed in the departments of soil technology, plant breeding, and entomology. The soil technology studies included an investigation of the formation of nitrates and other water-soluble matter in soils as affected by the growth of certain higher plants. The experiments as a whole dealt with the influence of the plant on the soil in distinction from the effect of the soil on the plant. A study was also made of the effect the soil moisture content may exert on the condition in which the plant nutrients are held in that soil. Further investigation was made of the conditions under which lime is removed from soils and of the changes that accompany it. In a study of certain properties of an unproductive soil, the qualities in correlation were determined and an effort was made to ascertain whether the amelioration of one condition would lead to a correction of others.

In plant breeding, a study of the laws of inheritance in hybridization was carried on with tomatoes, phlox, peppers, wheat, oats, corn, and browallia. Extensive studies were made with cereals, especially wheat and oats, to determine a possible correlation of characters that can be used practically in cereal breeding. An investigation of mutations and variations in relation to breeding was conducted to determine the value, cause, and meaning of mutations, their importance in the production of new types or species in nature, and their possible production by means of chemical or other artificial stimulation. The influence of environment in producing variations of importance in species and variety formation was studied, the work being conducted with pure lines of wheat and oats and to some extent with species of *Stellaria*.

The entomological work under the Adams fund included the study of the life history and habits of the tarnished plant bug and of joint-worms infesting grains and grasses, more especially timothy, together with their injuries to cultivated plants and the parasites which hold them in check.

Numerous additional lines of work were supported by Hatch and other funds. The investigations in soils and agronomy dealt with the nitrogen balance in soils, the comparison of different fertilizer practices in growing hay and grain crops, the examination of the chemical composition and of certain physical properties of the more important soil types of the State, the effect of different kinds and forms of lime on certain soils, the influence of continuous cropping, and local fertilizer experiments.

The department of plant breeding continued studies in timothy breeding with a large amount of material for field experiments. Work was also conducted in clover improvement, brome grass selection, breeding oats, wheat, corn, and potatoes, and in studies as to the

cause of resistance to disease and the possibility of breeding resistant strains.

The entomological work included studies of some of the external parasites of poultry, certain clover and elm-tree pests, and of the life history of the codling moth in western New York with a view to finding means of control for each one of these insects.

In plant physiology, attention was given to soil inoculation for leguminous crops and related topics, to peach yellows, wood development in peach, apple, and grape, physiology of growth and reproduction in apples, and to the influence of inorganic chemical reagents on the production of enzymes in fungi and chlorophyllous plants.

The plant pathological work included studies of diseases of ginseng, peony, gladiolus, peach, and bean, together with the investigations of the dead-arm disease of grapes, the Thielavia disease of violets, crown gall of apple and peach, hop mildew, and diseases of nursery stock. Diseases of forest and shade trees, particularly chestnut-bark disease, were also studied, and spraying experiments with different fungicides were carried out. Attention was further given to the fungus flora of the potato and of the soil.

Among numerous lines of effort in general animal husbandry, breeding experiments were conducted with dairy cows, sheep, and horses. The cost of production of winter lambs, colts, and heifers was studied and a comparison of oats and of corn and oats for feeding work horses was made. In poultry husbandry, work was pursued on the correlation of physical characters as an indication of egg production and on inheritance of fecundity, together with other phases of breeding. Methods of feeding and managing poultry and of keeping eggs for hatching were considered, and natural and artificial methods of incubation were compared.

The pomological department gave special attention to the value of selected scions, varietal studies, a survey of the peach industry of the State, and the effect of irrigation on peaches in a humid climate. Work with flowers and vegetables included studies of sweet peas and gladioli, and of fertilizers and crop accounting for vegetables.

The activities in dairy industry and technology included studies of cooling milk, moisture and salt in butter, testing cream, metallic flavor in butter, and of factors determining moisture content, yield, and losses of Cheddar cheese.

In farm mechanics, attention was given to the development of domestic sewage disposal systems, and in farm management work to accounting, laying out farms, cost of milk production on farms, and to making agricultural surveys.

A number of cooperative connections were in operation with this department, chiefly in soil surveys, plant breeding, farm management, and plant-disease investigations. A very large extension

cooperation was carried on with farmers of the State and the farm bureaus of Binghamton, Watertown, and Elmira.

The publications received from this station during the year were as follows: Bulletins 297, Studies of Variation in Plants; 300, The Cabbage Aphis; 301, Sweet Pea Studies; 302, Notes from the Agricultural Survey in Tompkins County; 303, The Cell Content of Milk; 304, Substitutes for Skimmed Milk in Raising Calves; 305, The Cause of "Apoplexy" in Winter-fed Lambs; 306, Classification of the Peony; 307, An Apple Orchard Survey of Ontario County; 308, The Plum Leaf Miner; 309, The Production of "Hothouse" Lambs; 310, Soy Beans as a Supplementary Silage Crop; 311, The Fruit-tree Leaf-roller; 312, Germination of Seed as Affected by Sulphuric Acid Treatment; 313, The Production of New and Improved Varieties of Timothy; 314, Cooperative Tests of Corn Varieties; Circular 11, Helps for the Dairy Butter Maker; and the Annual Report for 1911.

The income of the station during the past fiscal year, in addition to State funds, was as follows:

United States appropriation, Hatch Act.....	\$13,500.00
United States appropriation, Adams Act.....	13,500.00
Total.....	27,000.00

The Cornell Experiment Station is in a very prosperous condition and its influence in the agricultural affairs of the State has very greatly increased in recent years.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station, West Raleigh.

Department of North Carolina College of Agriculture and Mechanic Arts.

C. B. WILLIAMS, M. S., Director.

The past year at the North Carolina station was marked by the agreement upon a plan of consolidation of the college and State stations between a committee of the State legislature, the State board of agriculture, and the trustees of the college. The consolidated station is under the control of a board consisting of four members of the State board of agriculture, including the commissioner and of three members of the board of trustees, together with the president of the college. The plan went into effect January 1, 1912. B. W. Kilgore is director and C. B. Williams vice director and agronomist of the consolidated station. The State funds will be disbursed and audited separately by the State board of agriculture.

The changes occurring on the staff of the college station during the year included the resignation of F. L. Stevens, vegetable pathologist and bacteriologist succeeded by H. R. Fulton, and of R. I. Smith,

entomologist, succeeded by Z. P. Metcalf. The construction of an animal husbandry building, to cost \$30,000, was begun with funds provided by the State board of agriculture, and many minor improvements were made in the farm equipment.

The Adams fund work of the station advanced along the same general lines as previously reported. The study to determine the cause of the development of suckers on the corn plant and the relation their production and prolificacy in ears sustained to the yield of shelled corn under different degrees of soil fertility was continued with eight varieties of dent corn, representing the one-eared, medium prolific, and very prolific types. The varieties were each planted under seven different soil conditions, varying from very poor to very fertile. Thus far the yield of grain and stover has been greater with all varieties where the suckers have been allowed to remain than where removed at the usual stage of development.

The studies on the relation of soils to productivity and their fertilizer requirements were conducted with cotton and corn. Bacteriological and chemical studies were made of samples taken monthly from different plats, with results showing marked differences in the bacterial count of plats of different degrees of productivity. Studies were also made in this connection of the use of lime and of different carriers of phosphoric acid and nitrogen.

In the cottonseed meal toxicity work the important results secured with rabbits were checked up with swine. The feeding was both by natural and forced methods. Many chemical solvents, ferments, and digestive fluids were employed in securing extracts from cottonseed meal, all of which were nontoxic, while the residue was generally toxic. It was found that an alcoholic solution of caustic soda greatly reduces the toxicity of cottonseed meal. The results further showed that the seed of meal from Sea Island was just as toxic as that from Upland cotton.

The soil bacteriological investigations were confined largely to the determination of the ammonifying and the nitrifying efficiency of soils and their power of inoculation for bringing about or enhancing nitrification in soils, to a study of the effects of varying substances upon denitrification in soil and in solution, and to an attempt at isolation and study of the organism concerned in denitrification.

The work on the self-sterility of blackberries and dewberries was brought near to completion. Flowers of three varieties of dewberries and 23 varieties of blackberries were hand-pollinated and packed in continuance of the investigations. Of the 23 varieties of blackberries, 5 were found to be self-sterile, while the others were capable of complete self-fertilization. The results with dewberries have shown that varieties of *Rubus trivialis* are generally self-sterile, while those of *R. villosus* are self-fertile. The investigations on the nature and

cause of double flower in blackberries and dewberries were completed and the results published.

In the study of transmission of characters in hybrids of Muscadine grapes, several varieties were used in determining the transmissibility, and the causes governing the same, of such characters as color of berry, persistence of holding fruit, and size of fruit clusters. From the crosses of different varieties, 3,785 seedlings were grown in the field and the greenhouse and numerous crosses were again made during the year.

The investigations on the lettuce drop were practically completed and Bulletin 217 of the station was issued on the work. The apple-disease investigations had a bearing mainly on canker, wart, or twig disease, and orange rust or cedar rust. The study of yellowsides of cruciferous plants was suspended for lack of material and greenhouse facilities.

No work was done on the cabbage webworm, as there was no material to work upon. The corn billbug studies were practically brought to a close and considerable work was done during the latter part of the year on the life history of the gloomy scale.

In addition to these investigations, a number of different lines of work were supported by Hatch funds. The agronomist tested 38 varieties of cotton, 8 of corn, 17 of wheat, 21 of oats, 24 of cowpeas, 17 of soy beans, and 7 of adzuki beans. Special selection and breeding work was pursued with wheat and corn and some of the selections under test gave promising results during the year. In the study of seed value of corn kernels from different parts of the ear, the results continued to be in favor of those from the middle portion as compared with bud and tip kernels.

In horticulture, investigations were begun on the self-sterility and seedlessness of the persimmon as well as on the effect of varying soil fertility on the morphology and viability of pollen. Some pruning experiments were also started in the college orchard.

Experiments on tobacco and melon wilt were made in cooperation with this department. In the tobacco-wilt investigations a further study was made of the value of different soil disinfectants in overcoming or reducing this trouble. The effects of soil type, soil acidity, and subsoiling with dynamite on the development of the wilt were noted from cylinder and field experiments. The watermelon wilt experiments embraced 41 different selections. The plants showed a resistance of more than 95 per cent from the planting the year before.

The animal husbandry department finished a carload of beef cattle with rations of which the basal constituents were cottonseed meal and silage. It was found possible to feed as high as 9 pounds per day of cottonseed meal in connection with corn silage for over 120 days without injurious effect. Green feed and exercise were found to

reduce the toxic effect of cottonseed meal on hogs. Twenty ewes were bought to grade up the station stock preparatory to experimental work with sheep. With poultry, tests were made of rations for laying hens with varying amounts and kinds of animal food and of range, and tests were also made of the effect of the rations upon the hatchability of the eggs.

The publications received from this station during the year were as follows: Bulletins 213, Feeding Experiments with Cows and Calves; 214, Two Important Cantaloup Pests; 215, Cottonseed Meal Feeding Experiments with Mules and Horses; 216, Feeding Cottonseed Meal to Draft Animals; 217, A Serious Lettuce Disease; 218, Feeding Experiments with Beef Cattle; 219, Feeding and Management of Beef Cattle; 220, Care and Management of the Dairy Herd; 221, Profitable Poultry Raising; Technical Bulletin 8, A Serious Lettuce Disease (Sclerotinirose) and a Method of Control; and the Annual Reports for 1910 and 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products, including balance from previous year.....	8,286.73
Total.....	38,286.73

The work of the North Carolina station is in general definitely planned and proceeds with regularity. The reorganization of the station under the plan of consolidation with the State station will facilitate the work on many of the agricultural problems of the State, through a more effective combination of effort.

**Agricultural Experiment Station of the North Carolina State Department
of Agriculture, Raleigh.**

B. W. KILGORE, M. S., *Director.*

The work of this station during the past year was mainly devoted to the same questions studied for several years past and the funds were practically the same as the year before. A substation or test farm was established in the old bright tobacco belt for experimental work with tobacco. This farm is to be conducted in cooperation with this department and is an enlargement of the work along this line which has been in progress for several years. In like manner a substation was established in the black or muck soils of the State which are being reclaimed by drainage. These lands are being extensively opened and a number of important questions are arising in regard to their handling and the crops which are best suited to them. The solution of these problems is to be the work of the substation.

Among the more important work in progress was that on tobacco wilt, the study of air drainage and its relation to apple and other

fruit crops, investigations relating to the Scuppernong and allied grapes, mapping the soils of the State, and the eradication of the cattle tick, all lines of work carried on in cooperation with this department.

Bulletins presenting the work of the station were issued during the fiscal year ended June 30, 1912, on the following subjects: Insect Enemies of Cabbage; Conditions in the Red Clover Seed-trade of the State; Analyses of Fertilizers and Cottonseed Meal for 1910-11—Registration of Fertilizers; Pecans; Analyses of Illuminating Oils; Purity and Germination of Agricultural and Vegetable Seeds Sold in North Carolina; Wheat and Oats; Twelfth Annual Report on Food Adulteration under the Pure Food Law; Stock Feeds; Annual Report of Farmers' Institutes; The Influence of Soil Type on the Plant Variety; Cotton Culture in North Carolina; Analyses and Registration of Fertilizers, 1911; Analyses and Registration of Fertilizers, 1912; Hints on the Selection of Corn for Seed and Exhibition; The San José Scale—Orchard Spraying and Protection; and Corn Culture in North Carolina.

As mentioned in the foregoing account of the North Carolina station, these two institutions were consolidated during the latter part of the fiscal year.

NORTH DAKOTA.

North Dakota Agricultural Experiment Station, Agricultural College.

Department of North Dakota Agricultural College.

J. H. WORST, LL. D., *Director.*

The North Dakota station during the past year gave its entire attention to the pursuit of experimental work and investigation. No building operations were in progress, and the station itself remained about the same as the year before.

The Adams fund studies of the station, as in the previous year, was distributed in three departments. The botanist continued the project on tree physiology and medication, studying the artificial feeding of the corn plant for the purpose of verifying the results previously obtained with various species of trees. Experiments with corn were also conducted on the internal control through medication of corn rust and smut. The study of principles underlying the development of disease resistance in crops involved the breeding of cereals, flax, and potatoes along previously established lines. Histological studies were also made of the different varieties to determine the extent of their modifications as related to immunity. Considerable advance was made in the project on the relation of bacteria and fungi of soil to cropping methods.

The studies of the flora of the soil in relation to cereal, flax, and other diseases was continued and extended, and additional evidence of soil infection was secured. The bearing of these facts on crop rotation was carefully studied. A satisfactory method of growing wheat in an agar soil extract was worked out, for the purpose of growing healthy plants for inoculation experiments with cultures of various fungi. Experiments were also continued on the effect of bacteria and fungi of soil on its physical, mechanical, and chemical conditions. A study was made of the action of denitrifying organisms and of fungi in breaking down straw and stubble in soils. Data were further obtained on the physical and chemical nature of the soil as influenced by certain specific organisms.

In pursuing the investigation of swamp fever, a special study was made of diagnostic characters. Some work was done on complement fixation with rabbits and work with antigens was taken up. A test was made of Abderhalden's method of diagnosis of pernicious anemia. In general a large amount of data on the disease has been secured.

In connection with the investigation relating to the milling quality of wheat as affected by varieties, strains, soils, fertilizers, and other factors, studies were made of wheats grown at the station and on the 24 demonstration farms of the State. Results on the effect of phosphoric acid on the milling quality of wheat were ready for publication at the close of the year. Experiments were in progress with frosted, bleached, frozen, germinated, and bin-heated wheats to determine the changes taking place and the effect on the milling quality. Methods of treating or tempering grain to improve the milling quality were also studied.

The investigation of nutrition of the wheat plant and its relation to soil conditions consisted mainly of chemical studies of the various factors of soil fertility and exhaustion and involved fertilizer, rotation, cultural, and other experiments.

Numerous other activities of the station were supported by Hatch and State funds. The department of horticulture and forestry continued selection and improvement work with vegetables and with native plums, together with studies of different species of forest trees in their relation to drought resistance and hardiness. Some work was done on the control of injurious insects, as well as on a disease of box elder and methods of its treatment. Of American plum seedlings under test, several fruited for the first time during the past year and produced fruit of good size and quality. The botanist in addition to his Adams fund work carried on breeding experiments for disease resistance in flax and on a cooperative basis continued to distribute seeds of strains quite resistant to wilt. Considerable attention was given to pure-seed work under State funds and special studies were made of hard seeds of clover and alfalfa with reference to methods

of treating them for more timely germination. Other activities included studies of poisonous plants, quack grass, dodder, various root diseases, and related subjects.

The work of the chemical department comprised studies of wheat in addition to those under the Adams fund, studies of soil, effect of nitrification, availability of phosphates, fertilizer tests, and the effect of different crops upon the succeeding one in the rotation. The maintenance of soil fertility, culture experiments with sugar beets, and the presence of prussic acid in flax and flax straw and its effect on the health of animals also received attention. Waters from different localities of the State were analyzed and under special funds studies were made of China-wood oil, Lumbang oil, and soy-bean oil to determine their value for paints and varnishes, and experiments in cooperation with this department were made on the use of flax straw and wheat straw for paper making.

The agricultural department in its agronomy work continued the series of cropping experiments under long rotations with and without live stock in relation to the maintenance of soil fertility. A large amount of breeding work was done with corn, wheat, oats, barley, clover, alfalfa, and flax, and potato improvement work was carried on by means of pure-line hill selections. Some work was taken up on the irrigation of crops, including the study of the amount, time of application, and the efficiency of irrigation water and a minor study in tile drainage was also made.

In animal husbandry, poultry breeding for high egg production was continued together with the study of the effect of in-and-in breeding. Attention was further given to the cost of producing milk and pork and to the carrying capacity of various pasture crops.

The publications received from this station during the year were as follows: Bulletins 90, The Potato and Its Culture; 91, Dairy Herd Records; 92, Paints—Their Service Condition; 93, Wheat Investigations; 94, Swamp Fever in Horses; 95, Alfalfa; 96, Some Principles of Dry Farming; Special Food Bulletins 31–39, Vol. 2, Nos. 1–5; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation, including balance from previous year..	26,872.96
Miscellaneous.....	5,985.42
 Total.....	62,858.38

The work of the North Dakota station in general is making favorable progress, and the practical bearing of the different lines of study is of great value to the agriculture of the State.

OHIO.

Ohio Agricultural Experiment Station, Wooster.

C. E. THORNE, M. S. A., *Director.*

The changes in the staff of the Ohio station included several resignations and appointments in the corps of assistants, and the appointment of C. C. Hayden of the Illinois station as dairyman and of E. R. Allen as soil bacteriologist.

County experiment farms were established during the year in Clermont and Hamilton Counties, the areas being 130 and 216 acres, respectively. An appropriation was made for the purchase of the Germantown test farm. With this purchase consummated the station will own 950 acres in four counties, and will operate five additional farms with a total of 581 acres, including 21 acres held under lease. These outlying farms are used for the study of soil types, the maintenance of fertility, the effect of soil and climatic variation upon the different varieties of farm crops, crops adapted only to special soils, and problems in animal husbandry, as well as for local demonstrations of the practicability of the methods worked out at the main station.

The Adams fund work of the station was pursued along the lines originally laid down. State appropriations, however, made it possible to liberate the fund from most of the plant-breeding work, and it was therefore more largely devoted to the problems in plant and animal nutrition. The investigation on the rôles of lime and phosphorus in maintaining soil fertility involved the determination of the phosphorus and calcium carbonate content of different soils, represented by about 150 samples. In the work with phosphorus, the fertilizers used as well as the magnesium applied showed their influence on the composition of the crop. Similar studies were pursued with orchard plats under different methods of management. A study of the soil flora of plats was made to determine the effect of the different treatments in this respect. Reports of progress on this line of work were prepared for publication.

In the study of the rôles of phosphorus and other mineral elements in animal nutrition, four experiments have now been completed. About 60 complete ash analyses of different foods and feeding stuffs were taken as a basis for the consideration of the mineral elements in nutrition, and improved methods for determining crude fiber, sodium, inorganic phosphorus, and lecithin were worked out. Work was taken up on the specific effects of food on the growth of swine to determine their practical bearing. Digestion and metabolism work with pigs was practically completed.

The project on the increase of fixation of desirable properties in plants was continued as heretofore, and included a study of variation

in pure-line selections of wheat, corn, oats, clover, soy beans, and alfalfa. The results showed comparatively little variation in protein or in the number of seeds. The chemistry department made milling and baking tests of the wheat. A preliminary report on this work was made during the year.

Under Hatch and State funds the work in agronomy included a comparison of different leguminous crops for hay and forage, a study of the permanency of the common meadow grasses, study of the relation of the specific gravity of seed corn to yield, and a large amount of work on the fixation of desirable features in grains and forage crops.

In animal husbandry, feeding tests with horses, cattle, sheep, swine, and poultry were continued, and a study of animal parasites was undertaken with special reference to the lung and stomach parasites of sheep and swine. In dairying cooperative arrangements were made with two of the State institutions for correction, under which large herds of cows there kept were placed under the control of the station for investigational purposes. With poultry, experiments on the effects of confined and range feeding were in progress, and with sheep a study was made of individual fleeces to determine the actual wool yield. At one of the county farms, 1,800 acres were in use for studying the problem of economic pork production under a rotation system, including among other crops, rape, clover, and corn.

The entomological department continued the flour mill fumigation work which included about 14 mills and involved 50 to 60 species of insects. Studies were made of temperatures required to destroy the insects, the amount of radiating surface needed for proper heating, and the uses of hydrocyanic-acid gas, bisulphid of carbon, and other insecticides of that nature. Some studies of the bark beetles and the wheat leaf miner were completed, together with observations on insects in the lake region which were found to have special life histories. Attention was further given to certain shade tree and scale insects, and to pests attacking the sugar beet, and new data were obtained on the life histories of the gooseberry gall midge, the rose maggot, the locust leaf miner, and grasshoppers. Spraying tests were continued and the question of the relation to winterkilling of sulphite or arsenate of lead used in spraying was investigated.

The horticultural department under State funds undertook an orchard survey of the State, the information on hand covering nearly 8,000 acres of apple orchard. Work on the renovation and management of orchards and on the control of insects and plant diseases was carried further with good success. In addition, fertilizer experiments were conducted and cooperative work in spraying, thinning, fertilizing, and other orchard practices were in progress in the eastern and southeastern part of the State. In the conduct of this

cooperative work the station pursued the policy of restricting operations to orchards offering an opportunity to carry on some definite line of research for a considerable period of time. This department also conducted irrigation experiments with vegetable crops and good results were obtained.

In the department of botany the weed and seed work was continued and the plant-disease investigations comprised studies of apple blister, canker, European clover sickness in the Miami Valley, leaf-spot disease of the sugar beet, and under an emergency fund of \$2,000 granted by an emergency board of the State, studies of a destructive cob rot of corn, which made its appearance in the fall of 1911. The botanist cooperated with this department in the collection and dissemination of information regarding the occurrence of and remedies for plant diseases in Ohio, as well as in extensive studies of the tobacco plant.

In climatology, a bulletin was published containing statistics of temperature and precipitation in Ohio by months, seasons, and years since 1883, and of precipitation by months since 1856, together with maps showing the average dates of killing frosts and the average precipitations in different sections of the State. This work was conducted in cooperation with this department.

The forestry work of the station included a forest nursery containing over 1,000,000 tree seedlings and transplants, and cooperative work with farmers, State institutions and municipalities in the management of woodlots, institutional grounds and forests, and municipal forest parks.

The publications received from this station during the year were as follows: Bulletins 227, Farm Equipment; 229, The Fusarium Blight and Dry Rot of the Potato; 230, Thirtieth Annual Report of the Ohio Station, 1910; 231, Wheat Experiments; 232, Calendar for the Treatment of Plant Diseases and Insect Pests; 234, Flour Mill Fumigation; 235, The Climate of Ohio; 236, Strawberry Notes for 1910-11; 237, The Soy Bean and Cowpea; 238, Tobacco Culture in Ohio; Circulars 113, Alfalfa in Ohio—A Field Study; 114, Plans and Summary Tables of the Experiments at the Central Farm, Wooster, on the Maintenance of Soil Fertility, Arranged for Reference in the Field; 115, The Chinch Bug; 116, The Rural Population of Ohio—Where is It Increasing and Decreasing—Why; 117, Varieties of Corn in Ohio; 118, Farm Poultry; 119, Cooperative Forestry Work; 120, Plans and Summary Tables of the Experiments at the Central Farm, Wooster, on the Maintenance of Soil Fertility. Arranged for Reference in the Field; 121, The Seed Corn Situation; 122, Testing the Dairy Cow; 123, Carriers of Lime; 125, Apple Blister Canker and Methods of Treatment; 126, Dressings for Pruning Wounds of Trees;

and 127, Farm Management Field Studies and Demonstration Work in Ohio.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch act.....	\$15,000.00
United States appropriation, Adams act.....	15,000.00
State appropriation.....	193,500.00
Farm products.....	15,544.25
Miscellaneous.....	11,824.60
Balance from previous year.....	160,805.40
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Total.....	411,674.25

The activities and general condition of the Ohio station are evidences of its prosperity, and the large amount of both scientific and practical work pursued make the station one of the important elements in the development and the maintenance of the agricultural resources of the State.

OKLAHOMA.

Oklahoma Agricultural Experiment Station, *Stillwater*.

Department of Oklahoma Agricultural and Mechanical College.

J. A. WILSON, B. Agr., *Director*.

There was little change at the Oklahoma station during the past year in the lines of work or the membership of the staff. No buildings were constructed directly for the station, but buildings erected for the institution as a whole benefited the station by relieving congestion in certain quarters.

The Adams fund projects in force were continued, and three new projects were submitted and approved during the year. The work on the establishment of a breed of sheep for winter lambing included crossing experiments with the Dorset, Merino, and Shropshire breeds. Of the 39 cross-bred lambs secured the past year, 7 were Merino \times Dorset, 3 Shropshire \times Dorset, 19 Dorset \times Merino, and 10 Dorset \times Shropshire. One of the objects of a feeding experiment conducted during the winter was to make a comparison of the purebred and cross-bred lambs.

The breeding of drought-resistant corn and sorghums was continued at the station and at Goodwell. Physiological studies were begun at both places, and material was collected for anatomical and histological studies of the plants of different drought resistance. A series of experiments was conducted in the greenhouses with corn, Kafir corn, broom corn, and milo maize grown with different percentages of soil moisture, to determine the wilting coefficient and transpiration, and to study other points of importance connected with the subject. At Goodwell, the work was confined to varietal studies and continuous selection.

In the project on the effect of cottonseed meal and other highly nitrogenous feeds on breeding stock the quantity of cottonseed meal fed was increased gradually. Four lots of hogs were used in the experiments. Important data were obtained, and the relation between high-protein feeding and sterility was studied.

The work on artificial impregnation was confined to publishing Bulletin 96 of the station, which reports the results of an investigation on the vitality of the reproductive cells. The project is not completed and further work is contemplated.

The investigation of the cause of tomatoes dropping their blossoms without setting fruit included a test of 64 varieties to determine differences in this respect, and a study of the effect of shading the vines with about 50 varieties. Coordinate with this study, plants were grown in the greenhouse and outdoors to determine the effect of different conditions of growth on the vitality of the pollen.

The research work in the development of peach buds was practically held in abeyance, as the orchard planted for this work has not yet furnished material for study. Some investigations were made on the factors governing the amount of moisture and starch present in the twigs and the effect of these proportions on the succeeding growth.

For the study of the limits of grafting, some material was planted and some trees were dug up to test the strength of the union. Work on this project was begun during the year.

The investigation of the cowpea louse was pursued actively, mainly as a life-history study with reference to control. Work on the life history of the corn plant louse was entered upon and some new and important data on the white ant were secured. A study of the total reproduction and comparative reproductive capacity of bees was conducted with eight colonies. In general, the apiary was strengthened and placed in good condition for effective work in the future.

Under the Hatch fund the animal husbandman continued experiments with hogs on the feeding of alfalfa with and without grain, and conducted feeding work with 100 head of steers. In other experiments, hogs were fattened with cottonseed meal as a supplement, the feeding for 88 days of four parts of corn and one part of cottonseed meal being without effect upon their health. A test was also made of feeding cottonseed meal with and without corn stover silage to cows. For crate fattening of poultry, Kafir corn and maize and beef scrap and cottonseed meal were compared. Attention was also given to the value of silage for sheep feeding.

The agronomist carried on extensive field trials to test continuous culture of wheat and Kafir corn, varieties of field crops, rotations to maintain fertility, variation in depth of plowing different types of Bermuda grass, breeding of cotton and winter wheat, growing

winter oats and winter barley, dates of seeding winter oats, culture of cowpeas, and other phases of field crop work. A study was made of the relation of roots to drought resistance in corn and sorghums and other features of drought-resistant plants were observed. Some new land was brought into condition for the use of the department.

The activities of the horticultural department included work with timber trees, vegetables, growing and drying sweet potatoes, testing varieties of pecans, and grading seeds. A test was made of the use of dynamite for loosening up the subsoil previous to planting an orchard.

The entomologist studied the life cycle, number of broods, hibernation, and other phases of existence of the false chinch bug, together with the winter stage of the alfalfa webworm, and practically completed the work on the shot-hole borer and the melon louse.

The chemist pursued work on the chemical composition of alfalfa, the effect of fertilizers in crop production, the relation of depth of plowing to chemical composition of the crop, and on the amounts of plant food removed by different crops. The study of Kafir corn was continued, special attention being given to the fatty acids and proteids. Much of the work was in cooperation with other departments of the station. Feed control work under State funds required the analyses of 315 samples.

The veterinary department cooperated with the dairyman in the bacteriological study of stored butter and made bacterial analyses of town and city water supplies.

The dairyman made a study of the farm conditions and other factors affecting the quality of cream and butter. This work involved a study of the bacterial content, acidity, temperature, and age of cream upon its quality as influenced by different methods of milking, straining the milk, separating the cream, handling the cream after separating, and upon the quality of the butter.

The publications received from this station during the year were as follows: Bulletins 91, The Twig Girdler; 92, Spray Calendar; 93, Artificial Insemination; 94, Hog Feeding; 95, Varieties of Fruits Raised in Oklahoma; 96, The Vitality of Reproductive Cells; 97, Cotton and Cotton Culture; Circulars of Information 13, Selecting an Orchard Site; 14, Protecting Trees from Rabbits; 15, Some Types of Silos and Equipment; 17, Plans for Distributing Bermuda Grass; 18, Experiment Station Work, 1911; and the Annual Reports for 1910 and 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch act.....	\$15,000.00
United States appropriation, Adams act.....	15,000.00
Miscellaneous.....	3,119.97
Total.....	33,119.97

The Oklahoma station continued to make progress in the improvement of its work and in raising the grade of its efficiency. The influences which have controlled it have, however, been far from satisfactory, and have been a serious handicap to its development and to the provision of conditions essential to its best work. The situation became such during the year as to arouse public concern, and an effort was made after the close of the fiscal year to recall the board of agriculture, which is in control of the college and station, and secure the election of a new board more competent and more sympathetic in its attitude. While partially successful, the degree of improvement effected remains to be demonstrated. Pending this, the Oklahoma station must be regarded as in an unfortunate and unsatisfactory condition.

OREGON.

Oregon Experiment Station, Corvallis.

Department of Oregon State Agricultural College.

JAMES WITHYCOMBE, M. Agr., *Director.*

The Oregon station staff was enlarged during the past year by the appointment of several laboratory and research assistants, and the work at the substations was placed on a better footing by the appointment of superintendents and associate workers. Plans were drawn for a new dairy building to cost \$30,000, and 115 acres of land near the station was purchased for use as a college stock farm and for conducting the stock feeding experiments.

All the Adams fund projects of the station were actively pursued. In the investigation of lupulin and other active principles of hops, the study of the effect of kiln-drying at 145° F. was completed, the results showing little or no change in the composition of hops dried at this temperature. Work on new methods for the determination of resin in hops was also completed and a report on it was made. The ordinary methods and standards of judging hops were found unreliable. Analyses were made of hops from all important hop-growing centers of this country, and those grown on the Pacific coast were found highest in lupulin. Seed production and lupulin content seemed to be associated.

On the project relating to the chemical investigation of spraying materials, work was carried on to determine the exact reaction between calcium hydroxid and sulphur in the lime-sulphur mixture. The study of the primary reaction made it possible to determine a number of secondary changes. It was found that the size of vat, concentration of solution, temperature, and other conditions all influenced the composition of lime-sulphur mixtures. A study of self-boiled lime-sulphur mixture indicated that it contained very little polysulphids, a small quantity only of thiosulphate, and that it

was mostly a mixture of calcium hydroxid and sulphur. From these studies a theoretical basis was worked out for determining the proper proportions of lime and sulphur in preparing the mixture. Some work was done with lead arsenate and zinc arsenite and with soap used in connection with the lead arsenate. The influence of the soap on the solubility of arsenic was studied.

Considerable time was devoted to the studies of apple pollination and the conditions affecting the process. The field work on the mutual affinities between varieties was continued, but on a somewhat smaller scale than the year before. It was found that by the proper selection of varieties for pollination a greater percentage of fruit was set, the fruit exhibited a greater uniformity, and its size was also influenced by the application of congenial pollen. The investigation indicated that color of fruit was not influenced in any way by pollen and that the striping and banding of fruit sometimes observed is due to bud variations.

The results obtained in the project on the irrigation of fruit in the Rogue River Valley, in progress for five years, were published at the close of the year in Bulletin 113 of the station. The laboratory work on this project was somewhat broadened and studies were pursued on the rate of bud, leaf, and twig development, and on flower and fruit-bud formation, as affected by varying ratios of water.

In studying gummosis of the cherry, the causative organism was isolated from blighted spurs and its ability to produce gumming on stems and branches was demonstrated. It appeared that the disease starts through spurs or rough injured portions of bark. In studying the stock with reference to resistance, it was found that the Mazzard varieties were immune to a considerable degree.

The investigation of apple-tree anthracnose was largely a study of the life history of the fungus and means of its control. The perfect stage of the fungus was found and has been reported. The organism was recently found on the quince, a hitherto unrecorded host, where it was observed to cause a serious fruit rot. Thorough spraying with Bordeaux mixture was found to be an effective remedy. The work on this project was practically completed at the close of the year.

The project relating to the study of lime-sulphur spray was about closed out. Some further study was made during the year of the so-called lime-sulphur injury and the data secured were compiled for publication.

The poultry department actively pursued work on the incubation project and secured a large amount of data. The chemists and bacteriologists of the station cooperated in this work, most of which during the year related to studies of the effect of moisture and ventilation as well as of turning of eggs during incubation.

The work of the station under the Hatch and other funds was quite extensive.

The department of entomology made a study of the apple aphid, clover insects, and some of the insect pests of the strawberry. The crop-pest investigations conducted with State funds included a study of the shot-hole borer, codling moth, brown aphid of the apple, the root weevil and root borer of the strawberry, and the currant maggot. The preparation of an illustrated report on the principal insect pests of the State was also supported by these funds.

The horticultural department followed variety studies of strawberries, strawberry breeding, fertilizer tests with the loganberry, trials of orchard cover crops, comparisons of nut varieties, methods of pruning, breeding experiments with cherries, prunes, and apples, and vegetable growing work. Greenhouse experiments were conducted on the growing of cucumbers, cantaloups, peppers, and lettuce. The outdoor experimental work on vegetables was largely confined to the growing of winter cauliflower and tomatoes. The crop-pest work undertaken by this department related to frost prevention and tests were made of different grades of oil and different kinds of heaters. Attention was also given to the so-called winter injury, fruit spot, and to the prune industry.

The department of agronomy continued its work with rotations, adding several new soil-ing crops. The principal work in plant breeding was conducted with oats and barley, and the propagation of alfalfa and the effect of liming on its growth were studied. Tests were made of varieties of flax and of potatoes. The kale breeding work was continued as heretofore. The work in irrigation of western Oregon crops was continued along practically the original lines with the same general results.

The animal husbandry department conducted six hog-feeding experiments, in which different combinations of feed were used; cattle-feeding experiments, in which alfalfa hay was supplemented by rolled barley; and lamb-feeding tests to determine the difference in feeding lambs under shelter and in the open. The poultry work was along the lines of poultry breeding with the object of securing a general purpose fowl for farmers, an attempt being made to unite the desirable qualities of the Plymouth Rock, Leghorn, and other breeds.

In dairy husbandry, feeding experiments were made with kale for dairy cows with special reference to its effect upon the quality of milk, the quantity of milk produced, and the general condition of the animals.

The bacteriologist studied seed and soil inoculation for alfalfa, vetches, and clover, and undertook work with yeasts for the manufacture of ciders and vinegars. Under State funds bacteriological

examinations were made of water in different localities and pathological material of different kinds was studied.

Under State funds, considerable work was begun at a number of places in the State where local experiment stations have been established.

The publications received from this station during the year were as follows: Bulletins 110, Preliminary Frost Fighting Studies in the Rogue River Valley; 111, Orchard Management; Circulars 14 (Crop Pest Series 4), Insecticides for the Gardener; 14 (Vegetable Growing Series 2), Garden Management, II; 15, Two Apple Tree Borers; 16, A Method of Budding the Walnut; 17, Apple Tree Anthracnose (*Gloeosporium malicorticis*); 18, Swine Husbandry in Oregon—Diversified Crop Production for the Oregon Dry Farmer—Dairy Cows and Alfalfa—Poultry Production; 19, Oregon Station Trap Nest; and the Biennial Report of the Eastern Oregon Experiment Station.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	47,073.40
Farm products.....	7,252.22
Miscellaneous.....	2,599.06
Balance from previous year.....	45,530.02
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Total.....	132,454.70

Improvement in the affairs of the Oregon station continued during the year, and its field of activity, largely, as the result of generous State aid, was not only materially widened but also more thoroughly covered.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station, State College.

R. L. WATTS, B. Agr., M. S., *Director.*

Numerous changes on the staff of the Pennsylvania station during the year caused some interruption of the work and left the affairs of the station in a more or less unsettled condition. Since the close of the fiscal year, T. F. Hunt resigned as director to accept the directorship of the California station, and was succeeded after several months by R. L. Watts. The construction of a new horticultural building to cost \$40,000 was begun during the year.

As heretofore, the Adams fund work of the station was along well-established lines. The studies on the causes affecting yield and quality of apples were continued on a large scale, as in the year before. Four years' work on this project was written up for the annual report of the station, and a summary of five years' work was prepared as a

station bulletin. A relatively large amount of data has been obtained, and the work was brought to a point where fundamental studies of the soils of the orchard are to be undertaken to bring out the effects of the different soil treatments and their relation to the development and fruiting of the trees.

The results secured in the animal metabolism project were written up for the annual report of the station, and the work pursued during the year included several subsidiary experiments related to the main line of investigation.

The studies of the effects of fertilizers, manures, and lime on the soil and crops in the long-term rotation plats were continued along the lines mainly of the effects of fertilizers, manure, and lime on permanent pasture, the influence of fertilizers on the organic matter, humus, nitrogen, and acid soluble constituents of soil, the composition of wheat as affected by fertilizer treatment, and the lime requirements of the fertilizer plats and of different crops. Pot experiments on the growth of clover in relation to lime requirements of soil were temporarily suspended, but through the studies continued a large amount of data bearing on the relation of lime to soils, crops, and fertilizer treatment was collected.

Progress was also reported on two other projects based on the soils of the plats devoted to the long-term rotations, and relating in particular to the bacterial flora of these plats and to the effects of calcium and magnesium carbonates and oxids on the activity of the nitrifying organisms.

Numerous lines of work were supported by Hatch and State funds. The work on lime-sulphur spraying, which was written up and published during the year, included a consideration of the injury of the sulphur-arsenical spray and its prevention, recent advances in our knowledge of lime-sulphur, and of the use and value of the concentrated solution.

In olericulture, variety and selection experiments with cabbages were continued and a breeding experiment was conducted in which seeds from different commercial houses were used, and crosses were made with special reference to resistance to black rot. With early varieties of cabbage, experiments were made on time of sowing and the use of fall-grown plants, while with the late-growing varieties, tests were made of sowing versus transplanting, methods of cultivation, distance of planting, and of other cultural practices. Data were collected on the value of different strains of tomatoes, and marked variation in the productive capacity of standard varieties was found to exist. Differences in yield of different seeds amounting to $7\frac{1}{2}$ tons per acre were observed, and a yield at the rate of over 27 tons per acre was secured. The yield of each plant was recorded and selections were made on this basis. A statistical study of variations induced

by hybridization was begun as a part of the same general study of inherited characters, and work with asparagus was continued.

In vegetable pathology, apple collar rot, an obscure and as yet unnamed disease of apple trees, was studied, together with apple canker, chestnut blight, and diseases of tomatoes and clover. Some cooperative work was undertaken on the effect of smoke and soot on vegetation. A report was made by the retiring pathologist on the work with apple canker and diseases of tomatoes and clover.

The experimental work in forestry consisted mainly of tests of a large number of different kinds of trees under Pennsylvania conditions. Some work was also done on timber preservation and on testing different kinds of shingles.

The department of agronomy pursued experiments on the fineness and quantity of lime as affecting soils and crops, continued variety tests with potatoes, oats, wheat, corn, and timothy, and carried on work with alfalfa, including studies of soil, lime, fertilizers, inoculation, nurse crops, and other factors entering into its successful culture. Six of the best strains of timothy derived from the plants secured at the New York Cornell station were tested in comparison with those from ordinary commercial seed. Other lines of endeavor included rotation experiments on a large scale, experiments with deep versus shallow and fall versus spring plowing, together with dynamometer tests, spraying experiments with Bordeaux mixture and lime-sulphur on potatoes, head-to-row tests with wheat, and hill selection of potatoes. Soil-survey work was followed in cooperation with this department.

In animal husbandry, experiments with roughage and concentrates for beef animals showed that lean animals gained most rapidly on roughage for a considerable period, but later on concentrates were necessary. With silage as the sole roughage, the gains were satisfactory. Twenty Shorthorn and Angus breeding cows were fed on silage and 1 pound of cottonseed meal for five months and gained on an average 180 pounds each. Experiments in feeding silage and dry roughage to 40 Shropshire and Merino breeding ewes indicated that silage was satisfactory except that the lambs of ewes fed on silage appeared weak. Experiments with horses were continued as heretofore. With poultry the lines of work included the influence of crude fiber in the ration, the fattening of farm-grown birds, and the individual records of hens as influenced by their fondness for corn, wheat, or other elements in the mixed ration. A study was also made of the cost of raising beef animals of different breeds under Pennsylvania conditions.

The dairymen continued experiments in feeding dairy cows in open sheds and made a comparison of feeding mixtures of the same nutritive value fed to 18 cows. A cooperative feeding test with cows was also

in progress and different rations were fed to calves, with special reference to their effect on growth. Other lines of effort included observations on the prepotency of bulls, the test of a milking machine, experiments in making Swiss cheese, and bacterial studies of milk.

The publications received from this station during the year were as follows: Bulletins 110, The Control of Insects and Diseases Affecting Horticultural Crops; 111, The Maintenance Ration of Cattle; 112, Beef Production in Pennsylvania; 113, Work of the Agricultural Experiment Station for 1910-11; 114, Computation of Dairy Rations; 115, Preparation and Use of the Concentrated Lime-sulphur Spray; 116, Corn Growing in the East; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	5,000.00
Fees.....	13,652.50
Farm products, including balance from previous year.....	13,296.97
Miscellaneous.....	2,046.87
Total.....	63,996.34

The scope of activities of the Pennsylvania station continued to include problems of greatest interest and importance to the agriculture of the State, and it is to be hoped that the numerous changes in the personnel will not long interfere with their investigation.

The Pennsylvania State College Institute of Animal Nutrition, *State College.*

H. P. ARMSBY, Ph. D., LL. D., *Director.*

As heretofore, the central feature of the work of the institute consisted of investigations with the aid of the respiration calorimeter upon the fundamental principles of the nutrition of farm animals, conducted in cooperation with this department. In addition to the main line of investigation, several subsidiary experiments were carried on relating either to the technique of investigation or to other phases of nutrition problems.

Some additional equipment was purchased and certain improvements in the respiration calorimeter were made. A second electric furnace for the oxidation of combustible gases excreted by the animal under experiment was constructed, to take the place of a gas furnace previously used, and the refrigerating machinery which is the property of this department was repaired and put in order. Provision was also made for the installation of an apparatus for continuously and automatically recording the temperature difference, upon which the computation of the heat production by the animal is based. Material additions were also made to the laboratory and office equipment.

The subject of study with the respiration calorimeter during the year was the effect of fine grinding upon the availability of alfalfa hay, the comparison being made between ordinary cut hay and the so-called alfalfa meal. An improved form of adiabatic bomb calorimeter was completed and described and investigations were continued upon the methods of drying urine for analysis. Investigations were further taken up on the alkali excretion of cattle and on the electrical measurement of the body temperature of the experimental animal.

During the year the data with reference to the maintenance requirements of cattle were summarized in Bulletin 111 of the station.

PORTO RICO.

Porto Rico Agricultural Experiment Station, Mayaguez.

Under the supervision of A. C. True, Director, Office of Experiment Stations, United States Department of Agriculture.

D. W. MAY, M. Agr., *Special Agent in Charge.*

The Porto Rico station during the past year continued its work with good progress. The changes on the station staff were confined to the appointment of C. W. Hooker as entomologist, in place of W. V. Tower, who accepted a position with the Porto Rico Board of Agriculture. The insular government set aside for the use of the station 200 acres of land about 1 mile from the present station site, and this will be largely devoted to fruit growing.

The work with citrus fruits was largely a continuation of cooperative fertilizer experiments, studies in orchard management, investigations in bud variation, comparison of improved varieties, and the testing of various stocks. The conditions for marketing oranges were given attention and the value of care in handling, in picking, and in transit was demonstrated. The mango plantings of the station were increased by importations from a number of countries, and methods of propagation, testing of seedlings of different varieties, cultural methods, and investigations on handling and shipping of the fruit were continued. Ten of the superior imported varieties fruited at the station during the past year and all produced fruits of good quality. A considerable number of cooperative experiments were in progress for the purpose of impressing upon the attention of the planters some of the requisites to successful fruit production. These lines of work embraced experiments with grapefruit, oranges, and pineapples.

Testing of cover crops for coconut groves and a cooperative experiment on the fertilization of coconut groves on an area of 8 acres were begun, and in addition the subject of cultivation, selection,

nursery propagation, and other phases of coconut culture were given attention. Variety testing experiments in fertilization, planting, cultivation, and other similar lines were carried on with yams, yautias, dasheens, and sweet potatoes. The sweet potato proved only fairly prolific, although the tubers were of good quality, while the other crops mentioned were very thrifty and heavy yielders. An experiment in planting various species of Eucalyptus was begun, duplicating the varieties which in previous years were set on low, poorly drained land. These varieties now planted on higher ground did not make as vigorous a growth as on the lowland, but many of them which almost failed to grow in the first situation made a good growth on the higher lands.

The chemical work did not include any new problems, but definite progress was made in all investigations under way. These included studies on the bat guanos of Porto Rico, the effect of strongly calcareous soils on the growth and composition of various plants, the action of lime in inducing chlorosis in rice, field and plat work in connection with the study of chlorosis of the sugar cane, and plat work to determine the fertilizer requirements of red soils. The results of pot experiments and of a chemical survey of the pineapple soils of the island showed that the failure of pineapples with the appearance of chlorosis on certain areas is due to an excessive amount of carbonate of lime in the soil.

It was found that the chlorosis is not caused by an organic disease but is the result of a disturbance in the mineral nutrition of the plant induced by the calcareous character of the soil. No commercially feasible treatment was discovered and the remedy lies in abandoning pineapple plantings on calcareous soils to lime-loving crops. It was found that on the ordinary sandy soils a calcium carbonate content of about 2 per cent rendered them unsuitable for pineapples, while soils composed principally of organic matter were still capable of producing vigorous pineapple plants with a calcium carbonate content of about 40 per cent.

The work in animal husbandry made progress. One of the chief lines of work followed was experimentation in animal breeding and acclimatization. The horses taken to Porto Rico several years ago have attracted a great deal of attention among breeders and their service is in strong demand. The number of crossbred animals in the station herd of cattle, including half-bred Shorthorns, Guernseys, and Jerseys, has gradually increased and has replaced native stock. About 100 calves, much larger, hardier, and capable of making more rapid growth than pure-bred native calves, were obtained during the year from half-bred zebu bulls. The work with hogs was interrupted by the complete destruction of the herd by an infectious disease during the year. The work with poultry was continued with

success. In connection with live-stock development, experiments were conducted to obtain a grass producing good hillside pasture and proving fairly resistant to drought. Among the new introductions of forage plants giving promise of having considerable value were molasses grass (*Melinis minutiflora*), Rhodes grass, and *Paspalum dilatatum*.

The plant pathologist gave special attention to diseases of the coffee plant and particularly to one suspected of being harbored by coffee shade. A study was also made of a disease attacking the coffee berry and the fungus causing it was definitely determined, and a new disease attacking the trunk of the tree was partially worked out. A bud rot of the coconut, different from any hitherto reported, was found, and inoculation experiments demonstrated the ability of the organism in question to produce the disease. A canker disease of cacao was discovered and inoculation experiments showed that it is caused by the same fungus as that occurring in Surinam. A study was made of the so-called banana disease and efforts were put forth to determine the causative organism. The effects of soil disinfection and the use of fertilizers on this disease were also tested. Some work was pursued on the gummosis of citrus trees, anthracnose of grapefruit, and other plant diseases.

The entomologist, during the past season, took up the study of coffee insects and the mango fruit fly (*Anastrepha* sp.). The propagation and distribution of beneficial insects and fungi were continued and a colony of aphis-feeding ladybirds (*Hippodamia convergens*) was introduced. Further attention was given to beekeeping and experiments were made with cement for use in the construction of stands, bases, and brood chambers for bees. A tachinid parasite of the adult May beetle was found abundant in coffee plantations, and its propagation by the station for distribution was begun.

The publications received from this station during the year were as follows: Bulletins 10 (Spanish edition), Insects Injurious to Citrus Fruits and Methods of Combating Them; 11, Relation of Calcareous Soils to Pineapple Chlorosis; Circular 13, Beekeeping in Porto Rico; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation.....	\$30,000.00
Sales and other funds.....	5,028.95
Total.....	35,028.95

The Porto Rico station is filling an important place in the improvement and development of agriculture in the island. Its work is meeting with much appreciation, and its sphere of influence is very broad.

RHODE ISLAND.

Rhode Island Agricultural Experiment Station, Kingston.

Department of Rhode Island College of Agriculture and Mechanic Arts.

B. L. HARTWELL, Ph. D., *Director.*

The organization and work of the Rhode Island station was not materially changed during the year except that the position of horticulturist was abolished. There were a number of changes in personnel, mainly among the assistants, including F. S. Hammett, first assistant chemist, who resigned and was succeeded by P. H. Wessels. After the close of the fiscal year, Director H. J. Wheeler resigned to take effect December 1, 1912, to take charge of experimental and demonstration work for a large fertilizer company. He was succeeded as director by B. L. Hartwell, chemist of the station. The State appropriated \$75,000 for a new science building for the college, in which the division of biology of the station is to be housed, thereby making available more office and laboratory room for other departments in the station building.

The Adams fund projects undertaken by the station are conducted by the departments of biology and chemistry. The investigations on the losses of brooder chicks included a study by the chemist of the effect of concentrated nitrogenous feeds, such as cottonseed meal and beef scrap, on the composition of the chick, and a study by the biologist of the causes and methods of preventing loss of brooder chicks, including conditions affecting the forming and laying of the egg, incubation and brooding with special reference to egg infection, and infection from other sources. The feeding experiments were temporarily stopped following the death of the poultryman. In connection with this work some study was made of white diarrhea of chicks.

The preventive measures of fowl cholera which were studied included the production of active immunity by inoculating with certain nonvirulent cultures which were secured from outbreaks of the disease. An attempt was made to secure a serum, which later performed the same function. Progress reports on these investigations were published in Bulletins 146 and 150 of the station.

Investigations were continued on the etiology and pathology of blackhead of turkeys, as well as on the conditions which favor or destroy the causal organisms. Preventive measures and medical treatments for combating the disease included disinfection of the soil, the use of intestinal disinfectants, and modification of the feeds.

Investigations in breeding of domestic birds were confined during the year very largely to a study of the transmission of color pattern, and particularly to crossing to secure barring in fowls. This work also embraced a study of the transmissibility of the laying of large or small eggs. Studies were further made of Mendelian characters

in English and Belgian hares. The work in pigeon breeding in connection with this project was practically closed out.

The chemist continued the study of the effect of sodium carbonate and sodium chlorid on the composition of fodder beets and onions, and issued a report on the work.¹ The study of the relation of the phosphorus content of turnips to the phosphorus requirement of soils was also continued and reported upon during the year.²

The investigation of toxic conditions in certain soils embraced water culture, pot, and field experiments with rye and barley, to determine more particularly the effect of varying the potash and phosphoric acid supply at different stages of growth.

Work on the influence of one plant upon another grown in succession was continued on an extensive scale by means of pot and field experiments with various crops. Some very pronounced results were obtained but the drawing of conclusions was deferred until data covering a series of years have accumulated.

The results of five years' work on the influence of physical soil factors and of various chemicals on the growth of vegetables and flowering plants under glass were prepared for publication. The work on the lime and magnesium requirements of plants was not very actively prosecuted during the past year.

In addition to the Adams fund projects the station conducted a large amount of work, especially in agronomy. The rotation experiments for the purpose of learning the most economical means of renovating and maintaining the fertility of some of the neglected soils of the State were continued. One of the most important features of this work was the bringing out of the difference between two five-year rotations, in one of which clover is used and in the other omitted, the results showing that the clover is a quick-acting fertilizer and that no large effect of it is carried over for successive years, though some effect is visible in the yield of grain and more particularly in the stover. The growing of corn continuously with various cover crops was in progress, the results showing the great value of the introduction of legumes at the last cultivation of the corn crop. Experiments in grass culture were continued with the idea of arriving more definitely at the best formula for the growing of this crop where no stable manure is employed. The alfalfa experiments which were conducted in every township in the State were practically completed during the year and a bulletin on the subject was prepared. In this work various sources of lime were compared with each other and also different varieties of alfalfa and times of seeding. The residual effects of sodium salts by way of conserving the potash supply of the soil were also given consideration. The study of the after-effects of various phosphates was in progress on both limed and unlimed soils.

¹ See Orig. Commun. 8. Internat. Cong. Appl. Chem. 15 (1912), Sect. VII, p. 129.

² See Jour. Indus. and Engin. Chem., 3 (1911), No. 11, p. 831.

Experiments with lime from different sources with and without magnesia were pursued as well as the study of the effect of lime upon the growth of various crops. Selection and breeding work with corn was carried on for the purpose of improving the Rhode Island Cap corn and of getting better strains for seed purposes. Methods of planting corn in hills and drills were compared as in the last two years. Experiments with different amounts of fertilizers as guides in the carrying on of the rotations were conducted and experiments with grasses testing the effect of neutral, alkaline, and acid fertilizers were continued. A new experiment was begun last year with potash salts for market garden crops. A study was also made of the composition of the potato tuber as concerned with nitrogen upon the growth of the plant grown from it.

The results of five years' pot experiments on the nitrogen-gathering power of leguminous plants was reported during the year in Bulletin 147, and showed a very large collection of nitrogen from the air by this means under ideal conditions. Experiments which showed little effect of cow dung on the availability of raw phosphates were also reported. A new experiment was inaugurated for the purpose of determining more definitely than heretofore the value of the lime and also of phosphoric acid in basic slag meal as compared with the same ingredients from other sources.

Cooperative experiments with farmers for the purpose of studying the soil deficiencies of various sections of the State, and other similar work, including experiments with grass, potatoes, cantaloups, asparagus, soy beans, cowpeas, turnips, and beets were continued and the results covering a series of years were summarized in Bulletins 148 and 149.

The publications received from this station during the year were as follows: Bulletins 145, Protein Concentrates for Winter Chickens; 146, A Biological Study of Eleven Pathogenic Organisms from Cholera-like Diseases in Poultry; 147, The Gain in Nitrogen During a Five-year Pot Experiment with Different Legumes; 148, Field Experiments on Individual Farms; 149, Cooperative Experiments for the Purpose of Studying the Soil Deficiencies of Various Sections of the State; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Miscellaneous, including balance from previous year.....	4,703.32
Total.....	34,703.32

The Rhode Island station is well organized for carrying on lines of research and for making the results applicable to the conditions and problems of the farm. It is doing an important work.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station, *Clemson College.*

Department of Clemson Agricultural College.

J. N. HARPER, B. S., M. Agr., *Director.*

The appointment of the director of the station as dean of the agricultural department of the college was accompanied by the appointment of a number of assistants in the station. The new dairy building was occupied during the year, and the dairy barn approached completion toward its close. A tract of 200 acres was purchased near Florence for use as the Pee Dee substation, and was prepared for experimental work. An extension division of the college was organized during the year, with W. L. English in charge; and the station entomologist and pathologist were made State entomologist and State pathologist by a law creating a State Crop Pest Commission. The animal husbandman resigned near the end of the year.

Of the Adams fund work in progress, the study of cotton anthracnose was practically completed and a report published as Bulletin 164. Burying diseased bolls in the fall and planting seed taken from healthy stocks was found to be an effective means of overcoming the disease, and fall plowing gave good results in this respect under field conditions. A study was further made of means of determining healthy bolls in field selection of seed and of detecting the germs in seed. Some preliminary observations were made on the cause of shedding squares and young bolls in cotton, more particularly the effect of fertilizers and of moisture and temperature. Other lines of work in this connection included laboratory and field tests with diseased seeds, and a study of hulls from diseased seeds and of manure from cattle fed diseased hulls, as factors in the distribution of the disease.

The entomologist had in course of construction an incubation room with controlled temperature and moisture for the study of the effect of these factors on insect activity. Some field studies were made of wireworms, more particularly with reference to the influence of temperature and moisture on distribution, continuing and extending the work reported in Bulletin 155 of the station. The pupæ and adults of several species of wireworms were bred, and it appeared that other species besides *Horistonotus curiatus* were destructively abundant. Field work was also done on the cotton root louse at the Marion laboratory in the eastern part of the State.

Experiments to test the poisonous effect of cottonseed meal on milch cows and hogs were continued. These experiments showed that long-continued feeding of large amounts (6 or 8 pounds a day) of cottonseed meal to dairy cows results in serious udder troubles and other physiological disturbances. Ether, alcohol, and water extracts of the meal were made for tests on a large scale, and the effect of

heating on toxicity and the forms of phosphoric acid in the meal were also studied.

The chemist actively pursued the study of the partial insolubility in water of potash salts when mixed with basic slag, in the attempt to determine the cause. This study involved mainly the development and test of analytical methods. A study was also made to determine the presence of a combination of iron and potash and its effect as a factor in bringing about the condition of reduced solubility of the potash salts.

In the study of the effects of pollen from barren stalks of corn, it was found that the use of pollen did not decrease the yield of corn but apparently did affect the position of the ear upon the stalk, increasing the height.

In continuation of the work on the relation between soil type and the quality of staple in cotton, varieties were grown by 150 cooperators in practically every county of the State. It was found that the relative value of varieties varies widely with the type of soil. The breeding experiments with cotton included efforts to develop a high-yielding big-boll variety and a longer-staple high-yielding variety. A long-staple variety outyielding all other staple varieties grown in the State was developed at the station.

Evidence was accumulated during the year tending to show that *Rotundifolia* grapes are self-sterile in some cases. By artificial means, branches of the vines were forced into blossom before any other vines in the vineyard had reached the blossoming stage to escape the possibility of cross-pollination. Hand-pollination and bagging gave unsatisfactory results.

The station pursued a large amount of work with Hatch and other funds, including experiments to determine the fertilizer requirements of upland soils of the State for the various staple crops grown in different rotations; comparisons of different forms of nitrogenous and phosphatic fertilizers; breeding experiments and tests of varieties of cotton, corn, and barley; fertilizer experiments with oats and wheat; tests of cover crops; and tests of forage plants and of grasses for holding terraces.

The horticultural department conducted tests of varieties and methods of pruning and training grapes; compared yield and rust resistance of male and female asparagus plants; tested methods of combating pear blight; conducted variety trials with apples, peaches, and vegetables; and tested the effect of pruning and thinning peaches. With blackberries, variety trials were conducted and the influence of pruning on the yield and general behavior of the plant was observed. A study of rots and methods of keeping sweet potatoes was also made.

The entomologist gave attention to various insects, conducted cooperative spraying experiments in different parts of the State, and studied the budworm of corn in cooperation with this department.

In the animal husbandry department, 60 head of cattle were fattened with rations of cottonseed meal fed with cotton hulls, corn stover, or corn silage. In these experiments, account was taken of the value of the manure as well as of the meat produced and this was shown to be an important factor in the profit of the feeding. Experiments in feeding cottonseed meal to hogs did not give conclusive results. Four pounds of cottonseed meal daily were fed to four cows without serious trouble.

The chemist completed the investigations on sweet potatoes for starch making and other purposes, and reported the results in Bulletin 165. The results of a study of changes in the composition of the oat plant as it approached maturity were published in Bulletin 163.

Satisfactory progress in work at the Coast substation was reported. On the 100 acres which have been successfully drained, large yields of cotton, corn, and forage were obtained and experiments with a large number of grasses, forage crops, fruits, and vegetables were in progress as well as tests of various kinds and combinations of fertilizers. A large number of cooperative experiments with cotton, corn, and winter cover crops, including clover, vetch, and rye, and with fertilizers were conducted by the main station in different parts of the State.

The publications received from this station during the year were as follows: Bulletins 157, Permanent Lawns for the South; 158, The Apple-tree Tent-caterpillar; 159, A Chemical Study of Certain Sandhill Soils of South Carolina; 160, Analyses of Commercial Fertilizers; 161, The Southern Corn-root Worm in South Carolina; 162, Experiments with Varieties of Cotton; 163, Changes in Composition of the Oat Plant as it Approaches Maturity; 164, Cotton Anthracnose; 165, Sweet Potato Investigation; 166, Home Gardening in South Carolina; Circulars 1, Cotton Anthracnose—Survey of the Situation in South Carolina; 2, Tables of Field Crops; 3, The "Williamson Plan" of Corn Culture; 4, Home Mixing and General Fertilizer Formulas; 5, Results of Cooperative Experimental Work for 1911; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	14,900.00
Balance from United States appropriation, Adams fund.....	100.00
Farm products, including balance from previous year.....	6,935.11
Total.....	36,935.11

The South Carolina station is pursuing a number of lines of scientific and practical work for the benefit of agriculture in the State, and is thereby brought into close relationship with the farmer and his many problems.

SOUTH DAKOTA.**South Dakota Agricultural Experiment Station, Brookings.**

South Dakota State College of Agriculture and Mechanic Arts.

J. W. WILSON, M. S. A., *Director.*

Few changes took place at the South Dakota station during the past year. Since its close a few minor appointments were made, and E. W. Olive, botanist, resigned to take up work at the Brooklyn Botanical Garden. A State appropriation of \$1,000 was available for experiments with plants introduced from Siberia by the horticulturist.

The work on the Adams fund projects showed general advancement, but the excessive drought of the previous year interfered to a considerable extent with the results of the experiments in agronomy. Under the project relating to the influence of rotations upon the maintenance of soil fertility, samples of soils and crops were taken for analysis, but on account of the almost total failure of the crops in 1911, the results of that year were of little definite value, except as furnishing data on the availability of plant food. Moisture determinations were also made on the plats to collect data on the relation of rotation to moisture content.

The morphological studies of different field crops included experiments with 500 lots of wheat grown by the head-to-row method. Studies were in progress on the correlation of yield, stooling capacity, length of head, and other characters. Data were further secured on the height of plants, width and length of leaves, and other similar features for use in the correlation studies. Work of a like nature was pursued with corn in an endeavor to correlate high and low protein content, position of ear, weight, and yield.

The study of the digestibility of grains and fodders with horses was practically finished and most of the computations were completed. The phase of this study relating to the feeding of an unbalanced ration to horses was continued, using oat straw. At the completion of the period of feeding, some interesting pathological conditions had developed in the animals. The horses performed no work and were not shod while under experiment, but they developed lameness, with symptoms similar to the spavin group of disease. A study of the cause of this was undertaken by the veterinarian.

The data secured in the study of the effect of alkali waters on dairy products were published in Bulletin 132. Work on the effects of alkali waters on cows was carried on in two series of tests. The amount of mineral matter consumed by each cow in the water taken was determined, and an effort was made to ascertain the disposition of the mineral matter in the urine, feces, and milk. A considerable amount of data along this line was accumulated. The botanist and

veterinarian entered into cooperation with the dairyman to study the cause of the injury to cattle said to result from the use of alkali water.

In the study of lumpy jaw, a point was reached where the cultural features of the disease were given special consideration. Attempts were made to cultivate the organism under both aerobic and anaerobic conditions, as well as by the methods described by Wright in an article on the biology of the microorganism of actinomycosis.

The work on the improvement of hardy wild fruits of the Northwest by breeding and crossing was continued on an extensive scale, and a considerable number of hybrid plums reached the point where they are ready for distribution. Studies were also continued on apples and bramble fruits, as well as on roses and other ornamentals. The work with a large number of seedling apples furnished information regarding the elimination of undesirable combinations. A large amount of material in the nursery was discarded, including some of the graft hybrids of apples.

The Hatch and other work of the station covered quite a range of subjects. The agronomy department continued its studies on the systems of farming, giving particular attention to a comparison of live-stock farming with grain farming. Field tests made with alfalfa were reported during the year in Bulletin 133. Other experiments in progress embraced tests of various clovers and grasses, including brome grass and of disking alfalfa after each cutting. Rotation experiments with three and four crop successions were begun, together with experiments in corn breeding in which two different methods were under comparison. The horticulturist reported considerable work on selection and propagation of alfalfas brought from Russia, Siberia, and Turkestan. A successful method of transplanting was devised, the machine used being a modified tobacco planter. The subjects of soil inoculation, injury to alfalfa by disking, varieties of alfalfa, and similar topics also received attention. About 1,200 farmers throughout the State cooperated in this alfalfa work.

The work in animal husbandry was carried on along several well-established lines. The results of studying the value of sweet skimmed milk, sour skimmed milk, and buttermilk when fed as full rations with shelled corn for fattening pigs were published in Bulletin 136, and data regarding the value of silage as a sole ration for wintering steers were presented in Bulletin 137, which also reported on the value of different root crops when added to the grain ration for fattening steers. Observations were made on the value of the hog motor, a contrivance to make hogs grind their own feed, and on the cost of producing year-old calves. The stallion registration work devolves upon this department and 3,215 stallions were registered during the year.

The veterinarian in cooperation with this department distributed 15,500 doses of blackleg vaccine during the year, and carried on investigations on the immunization of pigs against hog cholera by the use of virulent blood injections. The hog-cholera investigation included an experiment on the immunity of the mule-footed hog against the disease.

In the dairy department, work was begun on the relative value of six different kinds of silos and the various materials for ensilage, as well as on the proper time of cutting it and the temperature changes taking place within the silo. A test was made of milking machines and the relation of hand and machine milking to the bacterial content of the product was studied. Observations were made on the efficiency and economy of a combination pasteurizer and ripener, and attention was given to the subject of keeping ice on the farm.

The botanical department continued its work on grain rust and confirmed previous results with reference to the presence of rust mycelium in grains. A large number of hand-picked samples of grain were grown showing the presence of rust in each case. Some investigations were conducted on the curly-top of beets and an attempt was made to determine the presence of organisms in connection with the disease. Other botanical work included studies of the sexual phases and life histories of rusts, of a dry rot of potatoes, and of alfalfa seed.

The chemist continued sugar-beet investigations along the original lines. The results were reported as very promising for the production of mother beets, seed, and seedlings. The original strains developed at the station were given further study, and a special effort was made to determine the one variety or strain best for the region. Some field work on the distance of spacing beets in relation to their sugar content was in progress.

The publications received from this station during the year were as follows: Bulletins 127, Breeding and Feeding Sheep; 128, Progress in Wheat Investigations; 129, Growing Pedigreed Sugar Beet Seed in South Dakota; 130, Some New Fruits; 131, Scabies (Mange) in Cattle; 132, Effects of Alkali Water on Dairy Products; 133, Alfalfa as a Field Crop in South Dakota; 134, More Winter Dairying in South Dakota; 135, Trials with Millets and Sorghums for Grain and Hay in South Dakota; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	15,500.00
Farm products, including balance from previous year.....	5,735.41
Miscellaneous, including balance from previous year.....	2,451.54
 Total.....	 53,686.95

The South Dakota station is developing along promising lines and within the proper sphere of station work. The results of its investigations are of much importance to the State.

TENNESSEE.

Tennessee Agricultural Experiment Station, Knoxville.

Department of the University of Tennessee.

H. A. MORGAN, B. S. A., *Director.*

During the past year the principal change affecting the higher positions on the station staff was the appointment of W. H. McIntire, of the Pennsylvania station, as associate chemist. Several changes were made in assistants both at the central station and at the sub-station at Jackson. An assembly hall and live stock pavilion costing \$15,000 was built during the year, largely with funds contributed by the East Tennessee Farmers' Convention. The pavilion is located on the station farm and is used especially for farmers' meetings.

All of the Adams fund projects were actively continued during the year. The more practical features of the clover-anthracnose project were completed by the development and distribution of a highly resistant strain of clover. Several additional counties were successfully supplied with this strain during the year. The plats of this clover at the station demonstrated that it had maintained its degree of disease resistance up to the sixth generation. The work during the season was largely concentrated on a study of the physiology of resistance, as exemplified in this case and as affected by external factors, such as temperature and moisture. For this purpose some elaborate apparatus was designed and constructed to control conditions.

In connection with the project on the breeding of apple and pear varieties for resistance to blight, the preliminary work included the growing of seedling apples and pears for the purposes of the investigation.

The study of tomato wilt was pursued actively, and with much success as regards the practical features of developing and testing resistant strains. This phase of the project was nearing completion and some of the results were presented in Bulletin 95 of the station. Large quantities of the seed of the resistant strains were secured for further distribution and trial, and a plan of rotation to avoid the fungus was worked out and recommended by the station. The work on this project was carried out largely at the station at Jackson.

As in previous years, much time was devoted to the studies on humus formation, particularly to the effect of lime and phosphates in that relation. The general purpose of the work was to obtain actual quantitative data on factors affecting humus and nitrogen in

soils from different parts of the State. Chemical studies were pursued in connection with cylinder and field experiments on soil fertility, and on the whole a large amount of data was secured on the project. The studies of the biological phase of the subject proceeded along the same lines as in the previous year.

The results of studies on the life history and habits of the cattle tick were published during the year in Bulletin 94. This work has apparently developed a law to the effect that the time of hatching and rate of development of the tick are governed by the initial temperature and the daily rate of increase rather than by the total accumulated effective temperature. The application of this in the case of plants is being studied.

The study of the peach borer was not active during the year, but a detailed plan of study of the hog louse involving essentially a study of the life history under natural and controlled conditions and of methods of control was perfected and undertaken. Elaborate apparatus was also devised for controlling conditions in this work.

A relatively large amount of experimental work was done with Hatch and State funds, especially in agronomy both at the central station and at Jackson. A most important feature of the experimental work on the station farm was the study of the maximum productive capacity of an acre of land as measured by beef production, which had been going on for several years. It was found possible to maintain four steers for 90 days on an acre of land. The best results were obtained with a succession of soy beans and barley which produced 638 pounds of beef per acre annually, nearly double that obtained by the single-crop system. Two new acres with other rotations were added to this experiment during the year. Experiments in the winter feeding of yearling steers to test silage versus cotton hulls with low, medium, and high cottonseed meal with and without shelter were carried on at Knoxville and Jackson, the results favoring silage with moderate amounts of cottonseed meal. Feeding in the open gave as good results as feeding under shelter.

The work in agronomy was not materially changed during the year, and included more particularly improvement of cereals by selection, tests of various rotations, experiments with lime and phosphates, tests of grasses and forage plants and green manures, drainage experiments, and fertility experiments on types of soils in different parts of the State. The breeding of a hardy beardless winter barley continued to give promising results and valuable selections were made from Poole wheat and from tall-oat grass. The agronomy work on the station farm is duplicated in large measure at Jackson. One very important practical result of this work was the demonstration of the great value of Lespedeza, or Japan clover, as a cover crop, forage plant, and soil improver. This proved especially valuable as

an orchard cover crop. Supplementary to the soil investigations, numerous comparisons between lime and ground limestone were made with the average result that approximately 2 tons of the ground limestone were as effective as 1 ton of the lime. In a comparison of different rotations, the more important field crops as well as the crops grown by truckers were taken into consideration.

The horticultural work of the year included summer pruning of peaches to increase uniformity of fruitfulness, tests of fertilizers, cover crops, and tillage for orchards and small fruits, study of root development of apples, selection of potatoes and effect of altitude on growth and quality of potatoes, tests of soil-building rotations for truck crops, and spraying experiments.

Investigations of the relation of weather and climatic conditions to the soy bean were continued. The station emphasizes the importance of tillage methods that will conserve the rainfall of wet periods and make it available during the time of drought that is likely to follow. A detailed study of the distribution of rainfall over the State was made to determine the amount of precipitation that occurs in light, moderate, and heavy rains for the various months and for the year, and also the number of days in each month on which light, moderate, and heavy rains may be expected to occur. A practical application of the data was made to farming operations. It was shown that the average rainfall for the State is ample for six times the average crop produced.

At the substation at Jackson, an effort to improve conditions for effective experimental work was continued. This substation already has a fine layout of experimental plats and well-planned experiments were under way. The plats and orchards were in good condition and provision was also made for the more simple experimental work in feeding.

The publications received from this station during the year were as follows: Bulletins 90, Fertility Experiments in a Rotation of Cowpeas and Wheat—I, The Utilization of Various Phosphates; 91, Relation of Temperature and Rainfall to Crop Systems and Production; 92, Experiments with Fertilizers and Field Crops on Important Soil Types of Middle Tennessee; 93, Tobacco Insects of Tennessee—Tobacco Culture in Montgomery County; 94, The Cattle Tick as Affected by Climate; 95, Notes on Tomato Diseases, with Results of Selection for Resistance; and Report of Cooperative and Extension Work in Agriculture in Middle Tennessee for the Years 1909–10.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products.....	8,135.95
Total.....	38,135.95

The Tennessee station continues to develop its different lines of work in accordance with the agricultural needs of the various sections of the State, and to secure a growing interest in its endeavors on the part of the farmer.

TEXAS.

Texas Agricultural Experiment Station, College Station.

Department of the State Agricultural and Mechanical College of Texas.

B. YOUNGBLOOD, M. S., *Director.*

Considerable advancement was made at the Texas station during the year, and especially in organizing the work at the 10 state substations which have an allowance of \$55,000 annually from the State. The feeding station at Fort Worth was moved to the college, where a tract of woodland of about 550 acres was secured for the purpose, 216 acres of which was cleared. Barns, silos, and feed lots and sheds were provided and about 60 head of pure-bred cattle were purchased. A station greenhouse was completed up to the installation of the heating facilities.

Under the Adams fund the soil studies included over 100 cooperative experiments to test out the work of the laboratory. A study on the active phosphoric acid in soils involved from 200 to 300 pot experiments. Potash and phosphoric acid were studied along much the same lines, and bulletins setting forth the results of some phases of the work were published. The relation of the total nitrogen of the soil to the nitrogen requirement was also investigated, and the results were presented in bulletin form. Soils from different sections were tested for acidity in its bearing on the relation between the potash and phosphoric acid. An attempt was made to get at the actual constituents of humus.

In pursuing the studies on the digestibility of the individual constituents of ether extract and nitrogen-free extract in certain Texas feeding stuffs, and on the composition of such feeding stuffs with reference to the primary constituents, 18 digestion experiments were made with sheep, using different kinds of hay and coarse fodders. Methods devised for the separation of the ether extract and the saponifiable and unsaponifiable fatty acids derived from these different kinds of hay and fodders were used in the laboratory work. The unsaponifiable fatty acids seem to be mainly wax alcohols with a low grade of digestibility, while the true fatty acids were more highly digested than the coefficient for ether extract would indicate. Work was also undertaken on the digestion of some of the more important carbohydrate constituents.

On the fundamental study of inheritance in cotton, a large amount of work in crossing was started during the year, and material was

gathered and prepared for tests as to relative size, length, and strength of staple. The work was duplicated at some of the substations. Reciprocal crosses were made by using Sea Island and Egyptian on Rowden and Melbane Triumph. This study was mainly with reference to the behavior of certain selected unit characters in inheritance.

In the horticultural breeding experiments the work with dewberries was discontinued. With raspberries and blackberries, selections were made from pure and from hybrid seedlings to improve flavor, appearance, and size of fruit. A spineless strain of blackberry was grown the second year, and from crossing the red raspberry and the blackberry 10 hardy hybrids with many of the raspberry characters were secured. During the season numerous crosses were made of the raspberry and *Rubus rubisetus*, a blackberry growing wild in Louisiana. The work was interfered with to some extent through the lack of proper greenhouse facilities.

In the work on inheritance in the honeybee, Italian and Carniolan bees were mated and the crosses were studied mainly with reference to color inheritance. Work was also pursued on a method for the control of matings. No work was done on the poisoning of the cotton-boll weevil with powdered lead arsenate.

Some work was in progress on the study of swamp fever, including mainly an attempt to determine how long the infection is carried by animals that have become infection carriers, and how long the blood retains its virulence after being drawn from the animal. It was found that blood may retain its virulence as long as 60 days and that by passing the blood through a porous filter its virulence is not lost.

With Hatch funds, the agronomist carried on a large amount of field work mainly with the culture and varieties of cowpeas, corn, sorghum, soy beans, cotton, peanuts, and other crops important to the State. Some rotation experiments were in progress and observations were made on the effect of planting cowpeas in fields of corn at different stages of growth. A study of the percentage of kernel to cob in different varieties of corn showed this factor to vary greatly. Some fertilizer tests with cotton and corn were conducted, and attention was also given to the use of dynamite in subsoiling for corn.

The horticulturist did some work on crown gall, mainly treating affected nursery stock after the removal of the galls with mercuric chlorid of different strengths, hydrogen peroxid, formalin, potassium permanganate, copper sulphate, salicylic acid, methylene violet, and other antiseptics. The results were thought to indicate that infected nursery stock can be disinfected by dipping in a solution of copper sulphate. Some material was collected preparatory to starting work with peaches to overcome a weakened condition in the peach stock of the State.

The animal husbandry work was conducted at the new feeding station established during the year, and consisted largely of simple feeding tests. A comparison was made of cottonseed meal and hulls and cottonseed meal and silage, together with a mixture of sorghum and Johnson grass hay for fattening cattle. With sheep, an experiment was carried on to test the value of feeding black strap molasses, and with steers on a ranch a test was made of the relative value of cottonseed meal, silage, and cottonseed hulls. Some sheep breeding work was also pursued.

The entomologist, among other lines of work, studied the life history of the wax worm and gave attention to the peach-tree borer. The veterinarian followed work on the means of controlling Texas fever and the chemist cooperated in the survey work of the Bureau of Soils and under State funds studied the value of paints.

The publications received from this station during the year were as follows: Bulletins 137, Alfalfa in Northwest Texas; 138, Cooperative Fertilizer Experiments with Corn, Cotton, Rice, Cauliflower, Peanuts, Onions, Tomatoes, and Potatoes, 1908, 1909, and 1910; 139, Electrolysis of Humus Solutions—An Improved Method for the Estimation of Humus; 140, Commercial Fertilizers; 141, Commercial Feeding Stuffs; 142, Practical Information for Beginners in Bee Keeping; 143, Observations on European Agriculture; 144, The Culture of Cigar Leaf Tobacco in Texas; 145, The Active Potash of the Soil and its Relation to Pot Experiments; and 146, The Forms of Phosphorus in Cottonseed Meal.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	14,715.35
Balance from United States appropriation, Adams fund.....	284.65
State appropriation.....	55,000.00
Farm products, including balance from previous year.....	3,079.97
Balance from previous year.....	1,510.10
 Total.....	 89,590.07

The Texas station made good progress during the year toward a better organization of its work, and in meeting the agricultural needs of the different sections of the State. The wide range of agricultural interests in its field presents unusual opportunities.

UTAH.

Agricultural Experiment Station, *Logan*.

Department of the Agricultural College of Utah.

E. D. BALL, Ph. D., *Director*.

Practically no changes took place in the Utah station staff during the year, but the working force was materially strengthened by the return of several men after completing courses of advanced training.

Work on most of the Adams fund projects in hand was advanced. The study of the production and movement of nitrates in irrigated and arid soils was continued and extended by introducing manure into parts of the continuously cropped plats, in addition to the rotation, including manuring introduced a year ago. The results of this work published in Bulletin 114 indicated pronounced variation in the nitric nitrogen content of the soil at different depths during the season, due to movement of water, variation in nitrification, feeding of the plants, and fixation of nitric nitrogen in the form of insoluble protein by microorganisms. The application of irrigation water had a distinctly beneficial effect upon the formation of nitric nitrogen, being greatest where 15 inches of water were applied. The study of the organic compounds in arid soils was continued and extended into new regions. Analyses were made of all dry farm areas in which crops had been raised for more than 10 years and the results were tabulated for publication.

The entomological department proceeded with the study of the life history of the alfalfa leaf weevil and means of its control. Attempts were made to discover places of hibernation and to determine the distance to which weevils will travel to secure suitable places for hibernating. The most successful methods of control continued to be along cultural lines. By means of disking, watering, and cultivation good crops were grown, while on untreated areas they proved failures, due to the presence of the weevil.

Work on the project regarding the effect of arsenical sprays on the life of orchard trees was also carried further, and the results of most of the work were summarized for publication. Studies made of orchards in different sections did not reveal any correlation between the amount of spraying done and the injury peculiar to western regions and generally called arsenical injury.

The studies on grasshoppers, sugar-beet insects, and strawberry insects were continued as opportunity offered. Sugar-beet pests, especially those causing curly leaf, were very abundant in the State and were studied extensively, together with army worms and web-worms which also attack the beets. It was reported that the egg of the sugar-beet flea-beetle was found for the first time in the spring of 1912. Further facts on the life history of all these pests were being worked out.

The poultry department reported progress on the breeding as well as the incubation work. The fourth-year records of the breeding pens proved so good that the hens were kept for another year, the records of some being surprisingly high for six-year-old hens. A marked correlation was found between the progeny of the high egg-laying strains and their daughters, and also between the low egg-laying strains and their daughters. The incubation work consisted

mostly in attempts to perfect the incubator, previously described. It was found possible to control moisture, temperature, and carbon dioxid, but with these all under control the results gave evidence that there are still other factors not yet recognized entering into successful artificial incubation. A special effort was made to discover what is still lacking as compared with the natural process.

A large amount of work along various lines and financed by Hatch, State, and other funds was pursued during the year. The chemist continued the work on the milling quality of wheat and prepared the results of the experiments up to date for the printer. These results are reported as showing the possibility of arriving at the amount of nitrogen in flour, bran, and shorts by the determination of the nitrogen content of the wheat kernel and the use of a factor worked out for this purpose. The soil survey work was also carried further and the results of the soil survey of the southern farm were published. In connection with the cooperative work in the study of the effects of arsenical poison, the chemist worked out a method for determining arsenic in soil.

The horticultural department continued its work on the summer pruning of apple trees and demonstrated that by this method the extent of winter pruning may be decreased and a large amount of what is called water growth eliminated. This work was also extended to peaches. The effect of varying quantities of irrigation water on the quality, flavor, and keeping quality of fruit was studied and it was found that late watering was injurious. Attention was further given to growing celery under local conditions, thinning apples, making cooperative tests of different varieties of peas for canning, and testing about 40 varieties of grapes furnished by this department.

The work in agronomy included the breeding of alfalfa by selection with about eight varieties. Hybrids produced from the different varieties were tested in comparison with the original strains. The potato and sugar-beet breeding work was continued with promising results and a test of the possibility of growing sugar-beet seed on a commercial scale begun this year gave gratifying results. A large number of forage crops were tested using alfalfa as a standard of comparison. A study was made of the loss by shrinkage of wheat in storage, and it was found that wheat from irrigated land and from arid land cut and thrashed in the usual manner gained weight instead of losing it, the gain in some instances amounting to 5 per cent. Experiments in progress with corn had reference mainly to the ripening of the crop and the storage for seed purposes.

The entomological department made a study of the life history of the wheat straw worm under arid conditions. Miscellaneous work on a new wheat pest and some further studies of the early life history of the codling moth were also pursued.

In animal husbandry, a feeding experiment with dairy cows was in progress to test the comparative value of the first, second, and third cutting of alfalfa when fed in combination with a light grain ration. The results indicated that the second cutting was equal to the first in the production of butter fat and milk. Cow-testing experiments were also carried on.

The dry-farm work was continued at the Nephi station, and with an increased number of observations it was found possible to eliminate a considerable number of wheat varieties that had been tested and to extend the work on a few of the more promising strains. The rotation work and cultural methods were continued and these together with soil-moisture studies gave valuable data making it possible to interpret results that were previously obscure.

The irrigation investigations, carried on in cooperation with this office, were continued on the Greenville farm with reference to the water requirements of sugar beets, potatoes, and the testing of flood waters. The results of all the previous work in irrigation were compiled and published during the year.

The publications received from this station during the year were as follows: Bulletin 114, *The Movement of Nitric Nitrogen in Soil and Its Relation to "Nitrogen Fixation"*; and Circular 5, *Boys' Potato Clubs*.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	16,064.72
Farm products.....	1,738.58
Balance from previous year, miscellaneous.....	573.07
 Total.....	 48,376.37

The Utah station is making material advancement in the extension of its work and in the solution of problems of great importance and value to the agricultural interests of the State.

VERMONT.

Vermont Agricultural Experiment Station, Burlington.

Department of University of Vermont and State Agricultural College.

J. L. HILLS, Sc. D., *Director.*

There were few changes in personnel or plan of work at the Vermont station during the year. G. C. Cunningham was appointed assistant plant pathologist, C. W. Carpenter assistant bacteriologist, and P. M. Lombard assistant horticulturist. A new greenhouse partly for station use was completed during the year, at a cost of about \$7,000.

Substantial progress was reported in most of the Adams fund projects. The new greenhouse was a great aid in the prosecution of the studies on the forcing of plants with aerial application of carbon dioxide. Some pronounced results were obtained in these experiments, particularly with leafy plants. Experience suggested some changes in the method of experimentation and prompted the importance of a chemical analysis of treated and untreated plants.

In the investigations on the relation of large, medium, and small seed in plant production, tests with sweet peas and spinach were concluded and studies on the flowering and seeding capacities of lettuce and radish were continued. Work was done further with peas, beans, sweet pumpkins, and Hubbard squash; and in addition to the size of seed, the past productiveness of the plant was taken into consideration.

Little work was done on resistance of potatoes to fungus and bacterial diseases, owing to the absence of such maladies. During the latter part of the year preparations were made for the summer of 1912 with the hope that weather conditions would permit the gathering of further data.

The investigations on the stimulating effect of Bordeaux mixture on the potato plant were continued with a view to working out the physiology of the pronounced stimulation observed. Some of the results of this work were published during the year. The project on the effect of age and climatic condition of the efficiency of Bordeaux mixture and other fungicides, as shown by the inhibitory effect upon the germination of spores, was continued by making microscopic studies of the physical structure of the precipitation membranes which are formed in Bordeaux mixture and other fungicides, for the purpose of determining the possible relation of these films to the effectiveness of the spray. Advance statements as to the results of these studies were made public during the year.

The study of potato scab, carried along lines similar to those followed last year, dealt mainly with the morphology, cultural characters, and modes of attack of the organism causing the trouble. Some advance was reported in the determination of the relation of the potato-scab organism to the soil Streptothrix. A large number of organisms isolated from American and European potatoes were studied, and some work on the effect of fertilizers and lime as well as on the prevention of scab by tuber and soil disinfection was conducted.

The study of Fusarium diseases of plants was mainly confined to asters, peas, and forest trees and had a bearing chiefly on soil moisture and lime content and fertility. Over 40 Fusariums were studied and the pathogenicity of several was determined by inoculation

experiments. A bulletin on the damping off of coniferous seedlings was published during the year.

No material change was made in the plan or scope of the investigations on the tolerance of forest trees, which were carried on at the station and at Williston. The prime object of the work was the determination of the lowest degree of light at which seedlings of white pine, fir, and hemlock will make starch. A detailed study was made of the physical conditions under which white pine reproduces, both in the forest nursery and in the adjacent forests, and of the relation of these factors to the structure of the seedlings.

The study of fundamental processes relative to the storage of sugars and other carbohydrates in the wood and in the bark of certain trees, which heretofore were carried on with the sugar maple, were extended to oak, birch, beech, apple, hickory, and pine. These studies involved the making of many drawings and much anatomical work.

The investigation of the protein and total food requirements of milch cows was continued throughout the year, and the large amount of data derived up to the present time regarding the effects upon milk production of feeding rations with narrow, medium, and wide nutritive ratios was prepared for publication. Similar investigations were pursued to determine the maintenance requirements of cows and the nutrients required for the growth of the fetus. The data concerning the nutritive value of various milks and their suitability for food for children and animals were also written up for publication.

Considerable work in addition to the Adams fund projects was carried on, including a comprehensive study of the susceptibility of different varieties of cabbages and other cruciferous plants to club root. Attention was also given to the prevention of the disease by the application of chemicals to the soil and to the young plants before setting. Peach-spraying experiments were in progress for the prevention of early and late blight. Work on the cause of eccentric growth in trees was carried on as rapidly as material became available.

The horticulturist carried on experiments in the runner propagation of strawberries as a means of increasing the yield and gave particular attention to a study of the influence of scion selection from apple trees showing high and low productivity. Observations were made on the effect of different methods of pruning on the productiveness of squashes, and inheritance studies with cucumbers were carried on, observations being made on the behavior in crossed plants of contrasting characters in the White Spine and English Frame varieties. In addition to the antithetic characters previously noted, seedy and seedless, spiny and spineless, and others relating to color

and nature of skin were included. The study of the Montreal market muskmelon industry was brought to a close during the year. The horticulturist also had charge of the nursery inspection.

The forester continued studies on the growth and yield of different species of trees and of spaces of planting and thinning. Much of the forestry work was done in cooperation with the Forest Service of this department. Various trials were made with different degrees of shading and other protection from evaporation. A study of the growth of hemlock in Vermont involved the making of volume tables based on the Vermont rule, observations on growth and management, form factors, and taper tables. Consideration was also given to the range of the more important tree species in the State and maps were prepared showing the data secured.

Other lines of work comprised a study of abortion in cows, including the development of an efficient and simple method of isolating and studying the germ; the study of methods of inoculation and of disinfection; and the preparation of the data for publication. A series of greenhouse pot experiments were begun by the station chemists with a view to showing the availability as plant food of different materials containing organic nitrogen. In dairy husbandry, the results of tests of the viability of weed seeds when ensiled were practically completed during the year, together with several other minor studies dealing with dairy husbandry.

The publications received from this station during the year were as follows: Bulletins 156, The Management of Vermont Forests with Special Reference to White Pine; 157, The Damping Off of Coniferous Seedlings; 158, Commercial Feeding Stuffs—Concerning Feeding—Standards—Summer Soiling Suggestions; 159, Plant Diseases—Twenty Years' Spraying for Potato Diseases—Potato Diseases and the Weather; 160, Commercial Fertilizers—Limes and Liming; Circulars 6, Forest Nursery Stock for Distribution in the Spring of 1911; 7, Plant Food Combinations for Sundry Crops; 8, Publications on Hand; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	3,021.00
Individuals, including balance from previous year.....	162.84
Fees.....	3,690.00
Total.....	36,873.84

The Vermont station pursues lines of practical and scientific work bearing directly upon the solution of problems confronting the agriculture of the State. Its efforts to aid the farmer are yearly more appreciated.

VIRGINIA.

Virginia Agricultural Experiment Station, *Blacksburg*.

Department of Virginia Agricultural and Mechanical College and Polytechnic Institute.

S. W. FLETCHER, Ph. D., *Director*.

The past year at the Virginia station was one of progress and of improvement in conditions. The organization of district experiment stations authorized by the State advanced well, and in this connection, experimental orchards were established at Cloverdale, Winchester, Fishersville, and Crozet, localities representing different sections of the Valley and Piedmont fruit regions. These orchards were established for experiments in tillage, pruning, fertilizing, and spraying. The station entered into a cooperative agreement with the board of agriculture, by which it took charge of the district experiment station at Staunton, consisting of 70 acres with 20 acres in plats.

Under the Adams fund the project on the effect of different methods of treatment and grazing on the growth, yield, and permanency of pasture grasses was continued in cooperation with this department. The results of five years indicated that heavy as compared with lighter grazing gave a closer sod and less weed growth. The experiments were conducted as heretofore, the quantity of grass produced and the composition being determined.

The study of protein and energy requirements for milk production was entered upon during the year with cows selected from the college herd and with 10 Holstein cows purchased for the purpose. With rations based on the milk production of the cows a preliminary feeding test was made in which the basal ration was compared with rations containing either a pound of starch or of black albumin in addition. A digestion experiment was conducted in this connection.

The results secured in the bovine tuberculosis project, which was closed out a year ago, were written up and presented for publication.

The breeding experiments with apples made good progress. Over 1,000 seedlings were being grown in preparation for grafting into dwarf stock to bring about early fruiting and for comparison of the merits of the different strains, particularly with reference to the transmission of characters.

The study of fruit-bud formation advanced satisfactorily and was largely confined to the dwarf trees grown in cylinders in which the soil moisture content is controlled and its effect studied as compared with the normal rainfall. An orchard was planted for this work at the station and also at Crozet on a different type of soil.

In studying the fixation of phosphoric acid by soils, four types of soils taken to a depth of 8 inches were used in experiments, including a series of 100 cylinders. This work had not gone beyond the effort

of developing reliable methods. The principal work on the project was conducted on field plats where the effect of rotations and cropping on the phosphoric acid in different forms was studied.

In pursuing the work on the relation of parasitic fungi and bacteria to their host plants, a study was made of photosynthesis and transpiration in healthy apple leaves and those affected with cedar rust. In the laboratory, efforts were made to develop methods for the extraction of enzymes in pure form and for the investigation of their number and their action. Articles on some of the results obtained in this work were published during the year in several scientific journals.

The investigation of nitrogen fixation and nitrification in different soil types was carried on with five types of soil and the effect of lime phosphate and sand in this relation was also considered. A study of the effect of lime and phosphates on ammonification was also included. Great differences in nitrification were found in the various soils, as well as between the nitrification outdoors and in the greenhouse in November and December. The nitrate-holding power of soils and the possibility of the fixation of nitrogen outside of the host plant by the nodule organisms of the leguminous plants were also considered.

Under the Hatch fund, the agronomist carried on work on the acclimatization of corn; the immediate effects of crossing strains of corn; the improvement of wheat, oats, soy beans, and potatoes; the comparison of home-grown and northern-grown potatoes for seed; and the culture of alfalfa, clovers, and grasses. The veterinarian conducted a feeding experiment for the purpose of studying the general subject of wintering stock cattle. The principal feeding work in progress was the pasturing of hogs upon a succession of forage crops which was carried on at Appomattox, near Norfolk, and at the station. In connection with this work, the use of corn and cottonseed meal to harden up the fat was tested. Some work was done on chronic diarrhea, showing it to be an infection, and on stomach worms in sheep.

The horticulturist conducted experiments in orchard management in four cooperative orchards, giving attention mainly to sod mulch, surface tillage, spraying, and the use of fertilizers. Work on the effect of temperature on the blooming of fruits was nearly completed. A study was also made of the laws of inheritance in garden vegetables, the F₂ generations being the subjects of the investigation. The test of the commercial value of dwarf apples was still in progress with results favoring the standard apple tree rather than the dwarf. The variety work on tree fruits was brought near to completion.

An experiment was conducted to determine whether the Phytophthora of the tomato is the same as that of the potato and an effort was made to determine how diseases are carried through the winter. Tests were made of different spray materials for combating leaf blight and a study of spinach diseases was carried on in cooperation with the

Virginia Truck Station. *Colletotrichum* was found in spinach grown out-of-doors. In cooperation with the State Crop Pest Commission, work was pursued on peach yellows to determine whether it is due to an organism or to an unorganized substance. Frog-eye leaf-spot of the apple received some attention as did methods of controlling cedar rust on the apple by spraying. A plant disease survey conducted in cooperation with this department was continued.

At the district experiment station at Staunton, considerable forage crop work was in progress in cooperation with this department. This included growing alfalfa alone and with clovers and grasses, using different kinds of lime in this connection and other similar experiments.

The publications received from this station during the year were as follows: Bulletins 191, Cabbage Club Root in Virginia; 193, Grass Culture; 194, Milk Standards—A Study of the Bacterial Count and the Dairy Score Card in City Milk Inspection; 195, Foliage Diseases of the Apple; 196, Crop Rotation and Fertilizer Experiments with Sun-cured Tobacco; 197, Growing and Curing Sun-cured Tobacco; 198, Crop Rotation and Fertilizer Experiments with Bright Tobacco; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$14,999.78
United States appropriation, Adams Act.....	13,635.73
Balance from United States appropriation, Hatch fund.....	.22
Balance from United States appropriation, Adams fund.....	1,364.27
State appropriation, including balance from previous year.....	9,459.17
Farm products, including balance from previous year.....	4,120.51
Miscellaneous.....	176.20
Total.....	43,755.88

The position of the Virginia station is strengthened each year. With its provision for work on local problems about the State and for cooperation with the State board of agriculture, it is in position to accomplish work of great practical value for the farmers and fruit growers of the different sections.

Virginia Truck Experiment Station, Norfolk.

Cooperating with the Virginia Agricultural Experiment Station and the United States Department of Agriculture.

T. C. JOHNSON, B. S. A., M. A., *Director.*

The improvements made during the year at the Virginia Truck Station included the drainage of a large portion of the station farm. No changes occurred in the station staff.

The station continued its work on the influence of certain commercial fertilizers on truck crops and on truck-crop soils, with special reference to the diseases of plants induced by excessive use of the

same. Observations were made on crop rotations as a means of overcoming these fertilizer troubles. Attention was further given to plant breeding, the work being conducted mainly with spinach and kale. In addition to these lines of effort the control of truck-crop insects and the application of irrigation in truck growing received attention. The results secured in the study of malnutrition demonstrated that the troubles attributed to this condition may be controlled to a large extent by proper crop rotation, by the use of fertilizers which do not tend to increase the acidity of the soil, and by the liberal application of stable manure.

The cooperative work of this station included spraying demonstrations and plant-disease investigations carried on with farmers of the State, studies of fungus diseases of spinach and of peach yellows in cooperation with the Virginia station, and certain lines of entomological work in cooperation with this department. The members of its staff cooperated with the State department of agriculture in institute work and with the agricultural college in conducting movable schools of agriculture, giving special attention to truck-crop work.

The publications received from this station during the year were as follows: Bulletins 6, Strawberry Culture; 7, Truck Crop Potatoes; and 8, Preliminary Report on Tomato Culture.

The income of the station during the past fiscal year was as follows:

State appropriation	\$5,000.00
State Board of Agriculture and Immigration	5,000.00
Farm produce	2,178.06
Other sources	250.00
Total	12,428.06

By means of its experiments along many practical lines and its cooperative work the Virginia Truck Station continues to render valuable service and assistance to the truckers and fruit growers in its locality.

WASHINGTON.

Washington Agricultural Experiment Station, Pullman.

Department of the State College of Washington.

R. W. THATCHER, B. S., M. A., *Director.*

The past year at the Washington station was marked by changes in organization and in personnel. The department of botany as a part of the station was abolished and in its place a department of plant pathology was established. The position of vice director was created and was filled at the close of the year by the appointment of H. B. Humphrey, the plant pathologist of the station. The department of agriculture was divided into the divisions of animal husbandry, crop production, dairying, and soil physics. In addition to the

appointment and resignation of several assistants, the changes in the staff included the appointment of O. M. Morris as horticulturist in place of W. S. Thornber, resigned, of G. A. Olson as chemist, of P. J. White as agronomist in place of L. Hegnauer, resigned, and the resignation of W. T. McDonald as animal husbandman. Since the close of the year R. C. Ashby was appointed animal husbandman, and R. W. Thatcher resigned the directorship to take charge of the department of agricultural chemistry of the Minnesota college and station.

The reports of the different station divisions showed satisfactory progress on the Adams fund projects being pursued. In connection with the work on the improvement of cereals in yield and in composition, the fifth and final year's crop indicated plainly that variations in nitrogen content of wheat are due to environment during growth, and can not be fixed as a type character by continuous line selection. The selection of seed from different parts of the head was continued, and investigations were conducted on the relation of the composition of wheat to soil types, and on the baking qualities of flour made of wheat from various parts of the United States and Canada.

On the project relating to the progressive development of the wheat kernel, milling tests and chemical analyses of wheats taken at the various stages of kernel development were continued, special reference being given to the different kinds of nitrogen compounds present in the wheat at the different stages and their effect upon the gluten content of the flour.

The soil moisture project was continued, with studies of the conservation and evaporation of soil moisture, drought resistance of plants, and the distribution of soil moisture by irrigation. The second year's measurements of the duty of water for different crops were made with reference to the kind of crop, the strength of soil solution, the wilting point, the temperature and humidity of the air, wind velocity, and intensity of sunshine.

Definite progress was reported on the study of the cause and methods of control of western tomato blight. The organism was isolated and inoculation experiments with cultures demonstrated that it was due to the organism studied. The general characters of the disease were found similar to those of the southern tomato blight.

The study of the blackberry and raspberry hybrids was followed with special reference to leaf and other characters. An attempt was made to determine unit characters in the species and establish their correlations in the progeny.

The winter desiccation of fruit trees was studied in the field and checked up by experiments in the greenhouse. The various possibilities as to its cause which were considered included alkalis, hard clays, hardpan, late irrigation, and other factors.

Owing to the marked decrease of pernicious anemia in horses little work was done on the study of that disease, only two cases being

available during the year. The effect of intravenous injection, from February to June, of nuclein and echinacea was studied as to its remedial value. The investigation of redwater in cattle was largely confined to the determination of the possible cause. The pathology of the disease was worked out and the infectious character of the malady was established.

The study of bud weevils was followed as originally outlined. The life histories of about 18 species were studied and methods for their control were laid down. The earlier stages of the insects were reared but other points in the life cycle remain to be cleared. The work on the effect of parasitism on the host insect related mainly to parasitized Aphides, the parasites and the hosts being studied in the laboratory during the winter. A large number of microscopic slides of sections of parasitized and nonparasitized insects were prepared during the year for further study.

The project relating to ground squirrels was enlarged to include other species, the Columbian, Townsend, and Douglas squirrels being the ones principally studied. The yard where the squirrels were kept under observation was enlarged, and considerable progress was reported on various problems relating to the life history of these rodents. The periods of hibernation, breeding, the food, and nesting habits were worked out but are to be confirmed by further investigation.

The work on the projects having reference to the effect of nutrition upon the development, maturity, and prolificacy of swine, the soil toxicity resulting from the growth of coniferous trees, and the starch production of potatoes particularly for use in making denatured alcohol, was temporarily suspended, owing to changes in the staff, and for this same reason but little was accomplished on the project relating to potato rot.

A large amount of work with other funds was reported. The animal husbandry work included experiments in testing forage crops for hogs and feeding tests of pea and oat silage for dairy cows. The tests of forage crops were carried on with alfalfa, field peas, field corn, and thousand-headed kale. Their value for pasture was also given consideration.

The division of chemistry, in addition to its cooperative work with other divisions, conducted experiments in liming alfalfa, analyzed insecticides and fungicides for sale in the State, cooperated in orchard fertilizer tests, and made studies of methods of analysis, particularly with reference to flour.

Special attention was given by the division of crop production to hybridizing and other experiments with cereals to obtain better varieties. The winter grains included in the work were wheat, barley, and oats and the spring grains, wheat, barley, flax, millet, and

oats. In connection with the studies in crossing, the laws of breeding as applied to plants were studied.

The division of entomology and zoology made observations on the food habits of birds and studied the distribution of animals in the State. Some attention was also given to the determination of the limit of toxicity of the lime-sulphur mixture. In connection with this work marked differences were noted in the resistance of the San José scale to this insecticide, indicating that well-developed strains of this pest exist which vary in respect to the effect produced upon them by lime-sulphur. Spraying experiments were carried on for the control of bud moths and for the eradication of such pests as oyster shell scale and apple scale from neglected orchards.

The horticulturist gave attention mainly to shade, wood, and forest trees, ornamental shrubs, and vines for use in the State. Observations were made on orchard pollination, methods of preventing frost, the use of winter sprays, and methods of top grafting trees.

The division of plant pathology took up a study of the stinking smut of wheat, the object of the experiments in progress being to determine the comparative value of different fungicides and the strength of the same to be used in seed treatment for controlling the disease. Laboratory experiments on the viability of smut spores and the conditions affecting their germination were in progress.

Under State laws the station did considerable inspection work relating to foods, drugs, fertilizers, insecticides, and commercial feeding stuffs, and also had charge of stallion registration.

The publications received from this station during the year were as follows: Bulletins 99, Field Pea Production in Washington; 100, Wheat and Flour Investigations; 101, Report of Investigations of Methods of Clearing Logged-off Lands in Western Washington; 102, Wheat and Flour Investigations; 103, The Control of the Codling Moth; 104, Twenty-first Annual Report, 1911; Popular Bulletins 33, Spraying Calendar for 1911; 34, The Soils of Washington; 35, Killing Ground Squirrels; Bulletins 4, rev. (special series), Practical Poultry Buildings; and 6, Thousand-headed Kale and Marrow Cabbage.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	20,943.64
Fees, including balance from previous year.....	1,025.39
Farm products.....	408.01
Total.....	52,377.04

The Washington station is shaping up its organization for the purpose of facilitating its administrative duties and of increasing its efficiency in research work and other lines of activity which produce results of use to the farmer.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station, *Morgantown.*

Department of West Virginia University.

E. D. SANDERSON, B. S. A., *Director.*

During the past year some changes were made in the organization of the West Virginia station, including a number of changes on the station staff, among them the appointment of W. H. Alderman as horticulturist and of I. S. Cook as agronomist. Several assistants were also appointed during the year.

Continuation of work on the different Adams fund projects was reported. In the studies on the effect of pressure in the preservation of fruits, vegetables, and milk, the death point of bacteria and other organisms was further investigated and curves were platted for the presentation of the results. Yeasts were killed as well as bacteria, but the actual cause of the death of the organisms was not determined. Only a small amount of work was done on spores. In all a large number of organisms have been tested, and the project was nearing completion.

Some work was done on the artificial fixation of atmospheric nitrogen by means of electrical discharges. The use of the new apparatus provided for the purpose continued to give relatively high yields of nitric acid.

The study of acidity in soils was limited to the effort of establishing a measure of the acidity, but no very definite results were secured.

Some further work was done on the study of the factors entering into the production of sanitary milk, and this line of investigation was brought to a close.

Studies on the influence of management and feeding on the vigor of germ in hens' eggs was prosecuted actively in cooperation with the chemist. Experiments were conducted to determine the possibility of changing the phosphorus content of the egg shell, and the effect of this change on the chick produced. Experiments were also in progress for the purpose of testing the effect of heavy egg production by the hen on the vitality of chicks and their subsequent breeding power.

In the project on apple rust, a histological study was made to determine the penetration of the disease into the fruit and whether it was developed after picking. The factors of infection were determined in the laboratory. Work in the orchard showed the relation of rain and evaporation to the development and spread of the disease through the dissemination and germination of the spores. Determinations of the date of infection were made, with the result that during the year it was found greatest about May 5. Spraying experiments indicated the feasibility of controlling the disease with Bordeaux mixture or lime-sulphur. Very little work was done on the project

relating to cucumber mildew. The study of potato tip burn was taken up with special apparatus provided for the investigation.

The horticulturist entered upon an investigation of the pollination of the apple, work being inaugurated in three different places.

The data secured in studying the relation of temperature to insect life was summarized for the purpose of making a report of progress.

Under Hatch funds the agronomist carried on experiments with corn, including variety tests in several localities of different altitude, fertilizer experiments at three outside points, ear-to-row selection, and breeding work. In addition variety tests were made with wheat, oats, field beans, and soy beans, and selection experiments with forage plants, especially timothy and alfalfa. Tests were also made of cutting clover for seed at different dates to avoid the clover midge. Rotation experiments were also under way.

The department of vegetable pathology conducted spraying experiments in repression of potato diseases, made cultural studies of diseased leaves of apple trees affected with "frog eye," and gave some consideration to the chestnut-bark disease. A study of collar blight in commercial orchards in cooperation with this department was made with special reference to the influence of bridge grafting.

The horticultural department pursued numerous lines of work. Severe and mild pruning were compared and the character and growth of the fruit as influenced by it were studied. Thinning experiments were carried on in three different orchards and the effect on the tree and the annual fruit production was observed. Selection experiments were in progress with sweet potatoes and variety tests with strawberries, bush fruits, peaches, apples, and potatoes. Cooperative fertilizer tests were made with peaches in one place and with apples in three different localities, while culture and pruning experiments were conducted in orchards in different parts of the State. Plant-breeding work with potatoes and strawberries was pursued and experiments on the control of bitter rot and in replanting of peaches were continued. In addition, attention was given to the use of dynamite in tree planting and the value of the hotbed in forcing vegetables for early planting.

The entomologist among other work studied the control of woolly aphis and of borers, and the poultryman tested large brooders with a view to bringing the losses of brooder chicks down to a minimum.

The publications received from this station during the year were as follows: Bulletins 134, Experiments in the Production of Sanitary Milk; 135, West Virginia as a Poultry State; 136, The Apple Orchard from Planting to Bearing Age; 137, The Chestnut Bark Disease; and 138, Commercial Fertilizers Inspection, 1911; and Circular 5, Condition of Seed Corn in West Virginia and How to Test it.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	14,250.00
Balance from United States appropriation, Adams fund....	750.00
State appropriation.....	11,500.00
Fees.....	12,920.03
Farm products.....	8,180.94
Balance from previous year.....	5,490.71
Total.....	68,091.68

The affairs of the West Virginia station are in good condition, and the change in directorship was accomplished with comparatively little disturbance of its work. An effort to strengthen some of the station activities is in evidence.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin, *Madison*.

Department of the University of Wisconsin.

H. L. RUSSELL, Ph. D., *Director*.

The more important additions to the equipment of the Wisconsin station during the past year included a crematory and quarantine building costing \$1,500; the establishment of a research poultry plant on a suitable tract of land and with incubator and brooding room, together with 15 colony houses and covered runs for breeding and physiological work; and the purchase of a creamery at Verona, about 10 miles from Madison, to maintain the supply of milk and cream for experimental work and to study problems under more general conditions than is possible at the university creamery. Progress was made in the construction of the buildings for agricultural chemistry and home economics, and in the improvement of the farm acquired a year ago. Additions to equipment were also reported at the branch stations at Spooner, Ashland Junction, and Marshfield, and at the cranberry station near Grand Rapids.

The Adams fund work of the station, including lines previously reported, was actively pursued. In connection with the study of the importance of mineral constituents of feeding stuffs, metabolism experiments with pigs and goats were conducted with reference to the rôle of calcium in maintenance, growth, and milk production. In experiments on the maintenance of mature pigs the loss of calcium in the cells was determined and a similar study was made of goats in milk and dry. The effect of lecithin-free rations on hens was investigated, and in metabolism experiments the relation of phosphorus to the composition of the egg was determined.

The study of nutrients from single plant sources and from different plants was carried on with 16 cattle, fed raw wheat and corn stover

in comparison with corn and wheat straw. A comparison was also made of feeding the nitrogen from alfalfa and from corn, and chemical studies of the nitrogen compounds in alfalfa were associated with this work. With hens, feeding tests similar to those with cattle were made and with pigs different amounts of protein from wheat, oats, and corn were studied. Some experiments on the effect of feeding the wheat kernel alone were carried on with rats.

Results secured in the study of the rôle of acid in Cheddar cheese making were published in Research Bulletin 25, and further data were in process of publication. Studies were continued on *B. lactis acidi* and *B. bulgaricus* and on the coccus forms, and an attempt was made to correlate the frequency of certain groups in the cheese with the most typical Cheddar flavor. A number of experimental cheeses were made on this basis and other relationships of bacteria to ripening and flavor were studied. The qualitative and quantitative chemical studies of the by-products of certain groups of organisms in Cheddar cheese ripening were continued, and work was also done on the relative amounts of certain volatile acids in good and poor cheese. A better method for separating lactic from citric acid was worked out.

In pursuing the project on the influence of soil treatment on the phosphorus content and its availability, a study was made of the relation of organic matter in soils to the phosphorus. A number of experiments were conducted on the leaching of phosphorus as influenced by different factors, and an explanation was sought of the effect on the availability of the element when manure is mixed with rock phosphate. An investigation was also made of the effect of individual plant characteristics on the availability of different forms of phosphorus.

Considerable work was done on the project relating to the rôle of bacteria in the digestive process, and the investigation was discontinued. The results obtained in the work on the physical and chemical changes in stored potatoes were written up for publication in scientific journals and the project was brought to a close.

The effects of continued inbreeding were studied in experiments with mice carried to the second and third generation, in distinct but related lines. Selections were made according to rapidity of growth to determine whether this is an inherited character. Similar work was also done with rats and guinea pigs. A study with hens, entered upon during the year, was confined largely to laying down plans and establishing methods for the pursuit of the work.

Numerous other activities were financed from the Hatch and miscellaneous funds. The soils department arranged a new experiment field in 10 and 20 acre plats for fertilizer experiments. Manure, phosphates, lime, and gypsum were used in different ways as bearing on

the problem of keeping up the fertility of dairy farms. Studies of special soils included heavy clays and marsh and sandy soils together with experiments on green manuring with leguminous crops adapted to acid soils. Considerable attention was also given to drainage problems, including vertical tiling.

The dairy department continued its work with cheese, giving particular attention to the uniformity of acidity and bacterial content of the milk and the improvement of quality in cheese including the reduction of the loss of fat. Other activities comprised observations on shrinkage in cheese, a study to arrive at the cause of the mottled condition of butter, and experiments in ice cream making. Attention was also given to the purification of creamery sewage.

The bacteriological department compared methods for determining the bacterial content of milk and carried on laboratory and field investigations in soil bacteriology. Studies were further made of the influence of green manure on seed germination and of the relations of soil bacteria and their products to different crops.

In vegetable pathology studies were in progress of the blight diseases of peas and barley and of the potato disease, *Phytophthora infestans*. In addition attention was given to diseases of cabbage and tobacco and to a plant disease survey of the State for the year.

The agronomical work consisted largely of experiments in the production and testing of improved grain and forage crops, together with studies on the quality and hardiness of alfalfa and tests of hemp as a weed eradicator and a money crop.

The animal husbandry department, among other topics, studied the influence of sulphur in feeds on wool production, the value for growth of the nitrogen in alfalfa hay, the use of corn silage for beef cattle, and the value of silage from sugar-beet tops and shocked corn.

The department of agricultural economics studied the cost of producing butter fat, the efficient distribution of farm capital, and the marketing of Wisconsin cheese, and made a social survey of a county of the State.

The publications received from this station during the year were as follows: Bulletins 210, The Progress of the Dairy Industry in Wisconsin; 213, Cranberry Bog Construction for Wisconsin; 214, Concrete Silo Construction; 215, Poultry House Construction; 216, The Use of Explosives in Clearing Land; 217, Practical Lessons from the Management of the University Dairy Herd; 218, Report of the Director, 1911; 219, Cranberry Bog Management for Wisconsin; 220, Better Cream Through Grading.—A New Butter Moisture Test; Research Bulletins 15, Experiments on Spore Germination and Infection in Certain Species of Oomycetes; 16, The Place of Economics in Agricultural Education and Research; 17, Physiological Effect on Growth and Reproduction of Rations Balanced from Restricted

Sources; 18, A Sclerotium Disease of Blue Joint and Other Grasses; 19, Effect of Heat and Oxidation on the Phosphorus of the Soil; 20, Factors Influencing the Availability of Rock Phosphate; 21, Studies of the Nutrition of the Pig; 22, Metabolic Water: Its Production and Rôle in Vital Phenomena; 23, Relation of Soil Bacteria to Evaporation; Circulars of Information 26, Standard and Undesirable Commercial Types of Potatoes; 27, How to Use the Babcock Test; 28, Distribution of Licensed Stallions in the Counties of Wisconsin During 1911; 29, A Method of Making a Social Survey of a Rural Community; 30, Chemical Analyses of Licensed Commercial Feeding Stuffs, 1911; 31, Commercial Feeding Stuffs and Fertilizers Licensed for Sale in Wisconsin, 1912; 32, The "Coming of Age" of the Babcock Test; and 33, Analyses of Licensed Commercial Fertilizers, 1912.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
State appropriation.....	15,000.00
Fees.....	11,474.03
Balance from previous year, farm products.....	9,000.00
Total.....	65,474.03

The research work of the Wisconsin station is carefully planned and conducted, and the environment of the workers is conducive to thoroughness. Its work for various sections of the State and for various agricultural industries is very effective.

WYOMING.

Wyoming Agricultural Experiment Station, Laramie.

Department of the University of Wyoming.

H. G. KNIGHT, A. M., *Director.*

The year at the Wyoming station was one of satisfactory advancement in most of the different lines of activity. The changes in the station staff included the resignation of L. C. Raiford, research chemist, who accepted a position at the University of Chicago and was succeeded by S. K. Loy, and the appointment of K. T. Steik to take charge of research in engineering chemistry. C. O. Merica resigned the presidency of the university and was succeeded by C. A. Duniway. At the close of the year C. J. Oviatt, assistant wool specialist, was granted leave of absence for graduate work, and L. C. Exelby entered upon his duties as assistant animal husbandman.

Under the Adams fund the wool investigations were continued, after the publication early in the year of a résumé of previous work. The principal subject studied was the strength of the wool fiber as influenced by humidity. A study of the strength of strands did not prove a better method for arriving at the breaking strength than work with

single fibers. The relation of diameter to strength was also studied, and the work on feeding and environment as factors influencing the quality and quantity of wool was continued.

Owing to the scarcity of material little work was done on lip-and-leg ulceration of sheep. In pursuing work on the swamp-fever project, attempts were made to transmit the disease by feeding infected blood and by the bite of the horse fly. The complement fixation test in which heart, spleen, and liver antigen prepared from known cases of the disease was used, did not give uniform results nor did these conform to the temperature reactions and other factors of ordinary diagnosis of the disease.

The study of the sheep tick was completed and a report on the life history of the insect was made. Consideration was given to the influence of temperature and dipping on the period of incubation, and control methods of greater efficiency were worked out.

In studying the life cycle of *Tænia fimbriata*, a common tapeworm of sheep, a special effort was made to determine how the sheep became infected, and to this end a number of experiments were conducted to test some of the theories held with regard to this matter.

Further work on the woody aster led to the discovery of an alkaloid in the plant, and to a study of its extraction and separation for the determination of its exact nature. The pathological nature of the green and the ripe plants was studied, and many post-mortem investigations of the tissues were made. Pathological work with the death camas was continued and the lesions caused by it were studied.

The effect of alkali on structural material was studied, mainly with reference to the effect on cement. Experiments in the preparation and on the efficiency of alkali-proof and salt-resistant cements were conducted. The chemical composition of the cement was determined before and after it was subjected to the action of the apparently injurious agencies, and the changes were noted. The effect of various waterproofers in preserving cement was also studied.

With Hatch funds, the agronomist tested 54 varieties of barley secured from this department and conducted fertilizer experiments on a series of plats as well as work on irrigation and in the breeding of oats. In addition to the variety tests of barley, considerable work with this crop was begun with reference to its culture, manuring, irrigation, stage of harvesting, and other cultural practices. Other activities included dry-farming experiments, cultural work with root and other forage crops, particularly oats and peas and tests with emmer. Seed treatment of potatoes was tested as a means of combating Rhizoctonia. An effort was made to work up the history of the agronomy plats from the time they were established.

In animal husbandry, sheep-breeding experiments were carried on and the meat and wool production of crosses was studied. Pasturing

and feeding tests were also made with sheep, but one of the experiments was interrupted by an outbreak of rabies. In a pig-feeding experiment, pea, rape, and grain pasture and corn meal alone, corn meal and middlings, and corn and alfalfa meal as finishing feeds were compared. Observations were also made on the relative value of native and alfalfa hay for horses. This department has bred up some good Polled Hereford stock in which the polled character has become fixed. The work on the establishment of a strain with the good qualities of the horned breed was continued.

The chemist, among other lines of effort, made the analyses of the feeds used in the feeding experiments, studied the relation of the soil to the high protein content of grasses, and took up digestion work with eight or nine different species of grasses and locally grown straws.

The publications received from this station during the year were as follows: Bulletins 89, Feeding Experiments, 1910-11; 90, Reclamation by Drainage; 91, The Relation of the Sheep-tick Flagellate (*Crithidia melophagia*) to the Sheep's Blood; 92, The Value of Fiber-testing Machines for Measuring the Strength and Elasticity of Wool; and the Annual Report for 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	13,850.59
Balance from United States appropriation, Adams fund.....	1,149.41
Farm products.....	1,629.04
Total.....	31,629.04

The general affairs of the Wyoming station are in good shape and much of the work in progress is of a relatively high grade. The station is much in need of State funds for the advancement of some of its lines of investigation. Funds are also needed for extension work

STATISTICS OF LAND-GRANT COLLEGES AND AGRICULTURAL EXPERIMENT STATIONS, 1912.

By BUTLER B. HARE, *Assistant in Agricultural Education.*

The following statistical statements relate to the institutions established under the acts of Congress of July 2, 1862, and August 30, 1890, most of which maintain courses of instruction in agriculture, and to the agricultural experiment stations, which, with few exceptions, are organized under the act of Congress of March 2, 1887, and are conducted as departments of the institutions receiving the benefits of the land-grant act of 1862. These statistics have been compiled in part from the annual reports of the presidents of these institutions made on the schedules prescribed by the Commissioner of Education. Tables showing the annual disbursements on account of the acts of Congress of March 2, 1887, August 30, 1890, March 16, 1906, and March 4, 1907, prepared from figures furnished by the Departments of the Treasury and the Interior, are also included. Owing to the complex organizations of many of the institutions, it is impracticable to give exactly comparable statistics in all cases, and in some instances the data furnished are incomplete.

SUMMARY OF STATISTICS OF LAND-GRANT COLLEGES.

Educational institutions receiving the benefits of the acts of Congress of July 2, 1862, August 30, 1890, and March 4, 1907, are now in operation in all the States and Territories except Alaska. The total number of these institutions is 67, all of which maintain courses of instruction in agriculture. The aggregate value of the permanent funds and equipment of the land-grant colleges and universities in 1912 is estimated to be as follows: Land-grant fund of 1862, \$13,533,868.64; other land-grant funds, \$3,390,215.83; other endowment funds, \$20,129,479.44; land grant of 1862 still unsold, \$5,165,209.81; farms and grounds owned by the institutions, \$22,023,266.60; buildings, \$44,459,391.12; scientific apparatus, machinery, and furniture, \$12,594,728.25; libraries, \$5,636,297.92; live stock, \$796,959.66; total, \$127,729,315.17. The income of these institutions in 1912, exclusive of the funds received from the United States for agricultural experiment stations (\$1,476,643.72), was as follows: Interest on land-grant funds of 1862, \$831,587.51; United States appropriation under acts of 1890 and 1907, \$2,520,502.54; interest

on endowment or regular appropriation, \$1,177,197.64; State appropriation for current expenses, \$6,937,410.97; State appropriation for increase of plant, \$4,647,746.97; income from endowment other than Federal or State grants, \$660,779; tuition and incidental fees, \$3,654,050.11; private benefactions, \$2,384,947.71; miscellaneous, \$2,296,065.41; total, \$25,967,130.45. The value of the additions to the permanent endowment and equipment of these institutions in 1912 is estimated as follows: Permanent endowment, \$1,809,100.40; buildings, \$4,721,467.79; libraries, \$283,725.62; apparatus, \$573,186.90; machinery, \$270,547.61; live stock, \$141,412.15; miscellaneous, \$438,721.40; total, \$8,238,161.87.

The number of persons in the faculties of the colleges of agriculture and mechanic arts for white persons was as follows: For preparatory classes, including secondary schools of agriculture, 626; for collegiate and special classes in agriculture, mechanic arts, and in all other instruction, 3,569; total, counting none twice, for interior instructions, 3,835. There were also 161 instructors giving full time and 525 giving part time to agricultural-extension work, 1,583 experiment-station officers, and 2,705 persons in the faculties of other colleges or departments, making a grand total, counting none twice, of 7,192 persons engaged in instruction and research in the land-grant institutions.

The number of persons in the faculties of the colleges of agriculture and mechanic arts for colored persons was as follows: For preparatory classes, 280; for collegiate and special classes, 107; total, counting none twice, 351. In the other departments the faculties aggregated 126, making a grand total of 474 persons in the faculties of the institutions for colored persons.

The students in 1912 in the colleges for white persons were as follows: (1) By classes—Preparatory or secondary schools of high-school grade, 7,248; collegiate, 30,532; postgraduate, 1,326; one to two year and winter courses, 10,845; summer courses, 4,749; total, counting none twice, in interior courses, 53,764. There were also enrolled in correspondence courses, 33,149; in extension courses of five days or longer, away from college, not including farmers' institutes, 106,516; in all other departments of the institutions, 32,685; total number of students, counting none twice, receiving instruction from these institutions, 242,954. (2) By courses: Four-year—Agriculture, which may include a number of students pursuing courses in dairying, animal husbandry, poultry husbandry, or other allied courses, 8,737; horticulture, 322; forestry, 487; veterinary science, 664; home economics, 2,664; engineering, 14,337. Shorter than four year—Agriculture, 8,905; horticulture, 272; forestry, 19; total, counting none twice, 9,196; veterinary science, 84; home economics, 1,103; teachers' courses in agriculture, 1,886 (one to three year, 188;

summer schools of agriculture, 1,698); mechanic arts, 541; military tactics, 19,954.

The students in colleges and schools for colored persons were as follows: (1) By classes—Preparatory, 5,317; collegiate, 1,544; short or special, 1,135; other departments, 596; total, 8,495. (2) By courses—Agriculture, 2,173; teachers' courses in agriculture, 821 (one to four year, 194; summer schools, 627); industrial courses for boys, 2,047; industrial courses for girls, 3,736; military tactics, 2,448.

The graduates in 1912 in the institutions for white persons were as follows: Agriculture, 1,200; mechanic arts, 2,260; home economics, 427; all other courses, 4,494; total, 8,370. The total number since the organization of these institutions is 103,736. The graduates in the institutions for colored persons were 131, and the total number since the organization of these institutions is 7,458. The total number of volumes in the libraries was 2,799,775, and the total number of pamphlets 823,410. The total number of acres of land granted to the States under the act of 1862 was 10,570,842, of which 652,617 are still unsold.

SUMMARY OF STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the acts of Congress of March 2, 1887, and March 16, 1906, in all the States and Territories, and under special appropriation acts in Alaska, Hawaii, Porto Rico, and Guam.

In Alabama, Connecticut, Hawaii, Louisiana, Missouri, New Jersey, New York, North Carolina, and Virginia separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the 48 States is 59, and in the United States, including Alaska, Hawaii, Porto Rico, and Guam, 65. Of these, 50 receive appropriations provided for by the acts of Congress approved March 2, 1887, and March 16, 1906, and 4 by other Federal enactments.

The total income of the stations maintained under the acts of 1887 and 1906 during 1912 was \$4,068,240.09, of which \$1,440,000 (Hatch fund, \$720,000; Adams fund, \$720,000) was received from the National Government, the remainder \$2,628,240.09 coming from the following sources: State governments, \$1,492,798.12; individuals and communities, \$54,878.51; fees for analyses of fertilizers, \$129,884.61; sales of farm products, \$230,271.81; miscellaneous, including all balances, \$720,407.04. In addition to this, the Office of Experiment Stations had an appropriation of \$424,000 for the past fiscal year, including \$30,000 each for the Alaska, Hawaii, and Porto Rico Experiment Stations, \$15,000 for the Guam Experiment Station, \$15,000

for nutrition investigations, \$100,000 for irrigation investigations, \$100,000 for drainage investigations, and \$10,000 for farmers' institutes and agricultural schools. The value of the additions to the equipment of the stations in 1912 is estimated as follows: Buildings, \$1,003,516.47; libraries, \$45,462.83; apparatus, \$71,492.73; farm implements, \$70,659.64; live stock, \$99,774.49; miscellaneous, \$215,221.79; total \$1,506,127.95.

The stations employ 1,583 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 57; assistant directors, 25; chemists, 250; agriculturists, 32; agronomists, 91; animal husbandmen, 120; dairymen, 90; veterinarians, 60; entomologists, 101; botanists, 61; horticulturists, 121; poultrymen, 40; plant pathologists, 61; zoologists, 3; meteorologists, 9; pomologists, 16; foresters, 21; mycologists, 21; biologists, 7; geologists, 2; plant breeders, 16; bacteriologists, 40; animal pathologists, 8; viticulturists, 5; soil specialists, 50; irrigation and drainage engineers, 26; agricultural engineers and farm mechanics, 15; extension work and farmers' institute directors, 19; farm management, 6; animal nutrition, 11; fertilizer and feed inspectors, 16; agricultural education, 5; in charge of substations, 55; farm and garden foremen, 43; secretaries and treasurers, 22; and librarians, 22.

There are also 56 persons classified under the head "Miscellaneous," including gardeners, laboratory and field assistants, herdsmen, editors, inspectors, etc. Six hundred and fifty-eight officers do more or less teaching in the colleges with which the stations are connected. During the year the stations published 719 annual reports, bulletins, and circulars, which were supplied to over 1,016,613 addresses on regular mailing lists. Most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

STATISTICS OF THE LAND-GRANT COLLEGES AND UNIVERSITIES.¹

Unless otherwise specified, the statistics reported in the tables are for the institutions as designated in the list given below.

Institutions established under the land-grant act of July 2, 1862, and their courses of study.

[All of the institutions in this list, except those marked with an asterisk (*), maintain courses of instruction in agriculture.]

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Four-year courses and degrees. ²	Shorter courses.
Alabama.....	Alabama Polytechnic Institute.	Auburn.....	C. C. Thach, M. A., LL.D.	Agr., civil engin., archit., elect. engin., mech. engin., mining engin., pharm., general chem. and metal. (B. S.), phar. (2 yrs., Ph. G., 3 yrs., Ph. C.), vet. med. and surgery (3 yrs., D. V. M.). Sci., agr., mech. (B. S. and B. Pd.).....	Agr., mech. arts (2 yrs.), applied electricity (2 yrs.), summer school for farmers (10 days).
Agricultural and Mechanical College for Negroes.	Normal.....	Normal.....	W. S. Buchanan, B. S. A.	Indus. and lit. studies (1 to 4 yrs.), teachers' training course; com. course (2 yrs.).	
Arizona.....	University of Arizona.	Tucson.....	Arthur H. Wilde, Ph. D.	Agr. (2 yrs.), prep. (4 yrs.).	
Arkansas.....	University of Arkansas.	Fayetteville.....	J. N. Tillman, LL.D.	Lit. (A. B.), sci., metal., mining engin., civil engin., mech. engin., elect. engin., agr. (4 yrs.) (B. S.), elect. engin. (4 yrs.), Agr. (S. A.), mech. engin. (B. M. E.), elect. engin. (B. E. E.), civil engin. (B. C. E.), mining engin. (B. M. E.), chem. engin. (B. Ch. E.), chem. (B. S. C.), phys. (B. S.), in Phys., lit. and sci. (B. A. and B. S.), music (B. Mus.), normal (L. I.). Clas. (B. A.), normal (L. I.).....	Agr., hort., dairying, elect. engin. (2 yrs.), mech. arts (2 or 3 yrs.), prep. (1 yr.), agr. (3 weeks), art (1 yr. and 4 yrs.); cor. courses in agr.; teachers' course in agr. (1 yr.).
*Branch Normal College.	Pine Bluff.....	Pine Bluff.....	F. T. Venegar.....	Prep. (3 yrs.), manual training, mech. arts (4 yrs.), agr. (2 yrs.), dom. sci. (4 yrs.).	
California.....	University of California.	Berkeley.....	B. I. Wheeler, Ph. D., LL.D.	Agr., animal indus. and vet. sci., irrig., poultry bus., dairying, nutrition, ent., vit., hort. (2-8 weeks each), summer session (6 weeks), farmers' week.	
Colorado.....	The State Agricultural College of Colorado.	Fort Collins.....	C. A. Lory, M. S., LL.D.	Agr., mech. arts, domestic sci. (3 yrs. of 6 months each; optional fourth year of 6 months for college entrance), farmers' and dom. sci. week.	

¹ Including also institutions receiving apportionments from the appropriations of 1890 and 1897.

² Four-year course unless otherwise specified.

Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Four-year courses and degrees.	Shorter courses.
Connecticut	Connecticut Agricultural College.	Storrs	C. L. Beach, B. Agr., B. S.	Agr. (B. S.)	Agr. (including dairy and poultry hush, and hort.) (4 yrs., diploma with 2 yrs. of previous preparation in high school), school of mech. arts., agr., home econ., (2 yrs. each), summer school of nature study and agr.
Delaware	Delaware College	Newark	G. A. Harter, M. A.	Arts and sci. (B. A. and B. S.), agr., general sci., civil engin., mech. engin., elect. engin. (B. S.)	Agr. (2 yrs.), farmers' week, 8 weeks course in agr.
Florida	State College for Colored Students. University of the State of Florida.	Dover Gainesville	W. C. Jason, A. M. A. A. Murphee, A. M., LL. D.	Arts (B. A.), pedag. (B. A. in Ed.), gen. sci., agron., hort., animal hush., agr.-chem., agr.-pedag., mech. engin., elect. engin., civil engin. (B. S.), law (LL. B.).	Normal (4 yrs.), industrial prep. (2 yrs.).
Georgia	Georgia State College of Agriculture and Mechanic Arts.	Tallahassee	N. B. Young, M. A.	Sci. (B. S.)	Agr., mech. arts. pedag. (2 yrs.), prep. (1 yr.), summer school for teachers (6 weeks), corresp. course in agr. for teachers and farmers, farmers' short course (4 weeks).
Hawaii	Georgia State Industrial College.	Athens	A. M. Soule, B. S. A., D. Sc.	General sci., agr., civil engin., elect. engin., forestry (B. S.), phar. (2 yrs., Ph. C.).	English (2 yrs.), high school (3 yrs.), grammar school (3 yrs., indus. and agr. training through all courses, corresp. course in agr. and laboratory courses in agr., hort., dairying (1 yr.), agr. (winter, 12 weeks), cotton trading (Jan. and July, 5 weeks each), cotton school (winter, 10 days), and stockmen's short course (Normal (3 yrs.) industrial prep. (3 yrs.), dairying (1 yr.).
Idaho	College of Hawaii	Savannah	R. R. Wright, A. M., LL. D.	College (A. B.)	Agr., dom. sci., miscel. (10 weeks), corresp. Agr. (3 yrs.), dairying (com'l, 1 yr.), forest rangers (winter), home econ. (3 yrs.), teacher's course in agr. (1 yr.).
Illinois	University of Idaho	Honolulu	J. W. Gilmore, M. S. A., J. A. McLean, Ph.D., LL. D.	Sci., agr., home econ., engin. (B. S.), Clas. (B. A.), sci. (B. S.), agron., animal hush., dairying, hort., forestry (B. S., Agr.), home econ. (B. S. A. E.), civil engin. (B. S. C. E.) mining engin. (B. S. M. E.), elect. engin. (B. S. E. E.), mech. engin. (B. S. M. E.), chem. engin. (B. S. Chem.), law (3 yrs., LL. B.).	Summer school, including secondary and el. agr. for rural teachers (6 weeks), agr. and domestic sci. (2 weeks).
	University of Illinois	Urbana	E. J. James, Ph.D., LL. D.		

Indiana.....	Purdue University.....	W. E. Stone, Ph. D., LL. D.	libr. sci. (B. L. S., 5 yrs.), med. (M. D.), dentistry (3 yrs., D. D. S.), phar. (2 yrs., Ph. G.), law (3 yrs., LL. B.), pharm. chem. (2 yrs., Ph. C.).
Iowa.....	Iowa State College of Agriculture and Mechanic Arts.	R. A. Pearson, M. S.	Mech. engin. (B. S. M. E.), civil engin. (B. S. C. E.), elect. engin. (B. S. E. E.), chem. engin. (B. S. Ch. E.), agr. (B. S. Agr.), sci., household econ. (B. S.), phar. (B. S.), Pharm., phar. (2 yrs., Ph. G.).
Kansas.....	Kansas State Agricultural College.	H. J. Waters, B. S. A.	Agron., dairying, animal husb., hort. and forestry, agr. engin., sci. and agr. (B. S.), vet. med. (D. V. M.), mech. engin. (B. S. M. E.), civil engin. (B. S. C. E.), elect. engin. (B. S. in E. E.), mining engin. (B. S. in M. E.), sci. (B. S.) ceramics (B. S. in Cer.), dom. sci. (B. S. in H. E.).
Kentucky.....	State University.....	Henry S. Barker, LL. D.	Agron., animal husb., dairy husb., hort., mech. engin., general sci., elect. engin., civil engin., archt., ind. jour., printing indus., journalism (B. S.), vet. med. (D. V. M.), home econ.
Louisiana.....	The Kentucky Normal and Industrial Institute for Colored Persons.	Lexington.....	Clas. (A. B.), mech. engin. (B. M. E.), civil engin. (B. C. E.), mining engin. (B. E. M.), agr. (B. S. Agr.), sci., dom. sci. (B. S.), law (3 yrs., LL. B.).
Louisiana.....	Baton Rouge.....	T. D. Boyd, A. M., LL. D.	Agr., elect. engin., chem. engin., civil engin., mech. engin., general sci., premed. (B. S.), commerce, Lat. sci., lit., philos., psychol., and ed. (B. A.), sugar engin., (5 yrs., B. S.), law (3 yrs., LL. B.), law (3 yrs., B. C. L.).
Louisiana.....	New Orleans.....	H. A. Hill.....	Scientific (B. S.), classical (A. B.)
			Sci. agr. high school, printing, girls' indus. (4 yrs.), clas., normal, manual training, grammar, mech., drawing, fmsmithing, wheelwrighting, dom. sci. (3 yrs.), bookkeeping, typewriting (2 yrs.), music (5 yrs.), agr. (1 yr. for students over 18 yrs.).

1 To take charge Sept. 1, 1912.

Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Four-year courses and degrees.	Shorter courses.
Maine.....	University of Maine....	Orono.....	R. J. Aley, Ph. D.....	Clas., sc., (B. A.) agron., animal husb., hort., home econ., chem., civil engin., mech. engin., elect. engin., chem. engin., forestry, phar., el. agr.; for teachers (B. S.), law (3 yrs., LL.B.), phar. (2 yrs., Ph. C.).	Secondary agr., (2 yrs.), agr. for teachers (1 yr.) home econ., for teachers (2 yrs.), agr. and dairying (4 weeks), poultry management, hort. (3 weeks, spring, summer school) for teachers (6 weeks, farmers' week, reading and correspondence courses in agr. and dom. sci.
Maryland.....	Maryland Agricultural College.	College Park.....	R. W. Silvester, M. S., L.L. D.	Agron., animal husb., hort., chem., gen. course, biol., mechan. engin., civil engin., elect. engin. (B. S.).	Agr., hort. (2 yrs.), prep. (1 yr.), agr. and hort. (winter, 10 weeks).
Massachusetts.....	Princess Anne Academy.	Princess Anne.....	T. H. Kiah.....	.....	College prep. and normal (4 yrs.), grammar (2 yrs.), indus. courses in agr., dairying, blacksm., wheelwr., carpentry, printing, dom. sci. and art.
Massachusetts.....	Amherst Agricultural College.	K. L. Butterfield, A. M., LL. D.	Agr. (B. S.).....	Agr., hort., floriculture, dairy ing. (winter, 10 weeks), poultry mg. (2 weeks), bee-keeping (May), summer school of agr., school gard., home econ., etc., for teachers et al. (2, 4, and 6 weeks), farmers' week, corresps. course.	Prep. (1 yr.), agr. for teachers (1 yr.), cheese making (4 weeks), general agr., poultry husb. (2 winter terms of 8 weeks each), creamery (2 winter terms of 6 weeks each), hort. (4 weeks, winter), forestry (1 summer term of 8 weeks each), college ext. See, agr. (3 yrs.), agr. (4 weeks), forestry, dairying (winter, 4 weeks), traction engin. (4 weeks), el. agr., nature study and dom. sci. and art for teachers (summer, 6 weeks).
*Massachusetts Institute of Technology.	Boston.....	R. C. MacLaurin, M. A., L.L. D., D. Sc.	Civil engin., mech. engin., mining engin. and metal., archi., chem., elect. engin., bio., phys., electro-chem., chem. engin., sanitary engin., geo. and geodet., naval archi., general sci. (B. S.).	.....	Sci., lit., and arts (B. A.), civil engin. (C. E.), mech. engin. (M. E.), elect. engin. (E. E.), mining, metal. (E. M.), Met. E., chem. (B. S. in Chem.), agr. (B. S.), forestry (B. S.), home econ. (B. S.), education (B. A. in Ed.), agr. (summer, 6 weeks).
Michigan.....	Michigan State Agricultural College.	J. L. Snyder, Ph. D., L.L. D.	Agri. engin., hort., forestry, home econ. (B. S. each 4 and 5 yrs.), vet. sci. (D. V. S.).	Agri., mech. engin., elect. engin., civil and mining engin., textile industr., indus. education, gen. sci. (B. S.).	Agri., mech. arts, textile (2 yrs.), prep. (1 yr.), pract. working boys' course (1 yr.), agr. (10 weeks), summer normal school
Minnesota.....	The University of Minnesota.	G. E. Vincent, Ph. D., L.L. D.	.....	.....	.....
Mississippi.....	Agricultural College.	J. C. Hardy, A. M., L.L. D.	.....	.....	.....

Alcorn Agricultural and Mechanical College.....	J. A. Martin, A. M.	Sci., agr. (B. S.)	for teachers (4 weeks), agr. (summer, 2-4 weeks), teachers' short course, industr. educat., agr., manual training, carpentry, blacksm., (4 yrs.), shoemak., nurse training, paint, dom. sci., millinery, etc. (3 yrs.), agr. (2 yrs.), college prep. (3 yrs.), primary (3 yrs.).
Missouri.....	A. R. Hill, A. B., Ph. D., LL. D.	Gen. sci. (B. A.), agr., home econ. (B. S.), forestry (M. E.), civil engin. (B. S., C. E.), mech. engin., min. engin. (B. S., M. E.), elect. engin. (B. S., E. E.), chem., engin., chem. and metal. journalism, educ. (B. S.), law (3 yrs., LL. B.). Collegiate (B. A.)	Agr. (winter, 2 yrs. of 14 weeks each), mining and assaying, electricity, surveying (2 yrs. each), summer school for teachers (9 weeks), poultry husb. (winter, 7 weeks), farmers' week, dairying, agr., home econ. (winter, 7 weeks). Normal, subnormal (4 yrs. each), industr. draw., carpentry, blacksmithing, mach. and engin. (2 yrs.), summer school (9 weeks), music (8 grades).
University of Missouri.....	B. F. Allen, A. M., LL. D.	Prep., music, art (4 yrs.), sec. agr. (3 yrs.), home econ. (1 yr.), animal husb. (winter, 2 weeks), soils, field crops, hort., dairy-ing, and poultry.	Vocational agr., home econ. (4 yrs. each), high and normal and grade and rural school teachers' courses in agr., home econ., and manual training (1 yr. each), home econ. for teachers (2 yrs.), agr. (winter 7 weeks), teachers' summer school (8 weeks), including agr. and home econ. (3 weeks), corres. courses in soils, cereal and forage crops, and elementary agr. for high-school teachers.
Lincoln Institute.....	J. M. Hamilton, M. S.	Mech. engin. (B. M. E.), elect. engin. (B. E. E.), civil engin. (B. C. E.), agron., animal husb. and dairying, hort., home econ., chem., biol., math., phys., history-lit., phar. secretarial (B. S.), phar. (2 yrs., Ph. C.). Clas., lit. (B. A.), general sci., general agr., home econ., agr. engin., civil engin., elect. engin., municipal engin., mech. engin., forestry, phar. (B. S.), teachers' course (B. A. and B. S.), med. (M. D.) law (3 yrs., LL. B.), phar. (3 yrs., Ph. C., 2 yrs., Ph. G.).	Winter short course in dairying.
Montana.....	Bozeman.....	Samuel Avery, Ph. D.	Liberal arts (B. A.), mining engin., agr., domestic sci., mech. engin., civil engin., elect. engin., edu., general sci. (B. S.). Agr., mech. engin., elect. engin., chem. engin., arts and sci. (B. S.).
Nebraska.....	University of Nebraska.....	Reno.....	Clas. (A. B.), Lat. sci. (Litt. B.), general sci., agr., civil engin., mech. engin., engin., chem., biol., and ceramics (B. S.).
Missouri.....	The New Hampshire College of Agriculture and Mechanic Arts. Rutgers Scientific School, the New Jersey State College for the Benefit of Agriculture and Mechanic Arts.	Durham.....	W. H. S. Demarest, A. M., D. D., LL. D.
New Jersey.....	New Brunswick.....	New Mexico.....	W. E. Garrison, Ph. D.
New Hampshire.....	W. D. Gibbs, D. Sc.	Agricultural College of Agriculture and Mechanic Arts.	Agr., mech. engin., civil engin., elect. engin., household econ., commerce, general sci. (B. S.).
New Mexico.....	W. E. Garrison, Ph. D.	Agricultural College of Agriculture and Mechanic Arts.	Sec. industr. agr., industr. mech., industr. dom. sci., industr. business prep. (4 yrs. each), Engl. and Engil.-Spanish sten. (1 yr. each), farmers' week.

Institutions established under the land grant act of July 2, 1862, and their courses of study—Continued.

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Four-year courses and degrees.	Shorter courses.
New York.....	New York State College of Agriculture at Cornell University.	Ithaca.....	J. G. Schurman, A. M., D. Sc., LL. D.	Arts (A. B.), civil engin. (C. E.), mech. engin. (M. E.), elect. engin. (E. E.), archi. (B. Arch.), agr. (B. S. A.), vet. med. (3 yrs., D. V. M.), graduate law (3 yrs., LL. B.), med. (M. D.), chem. (B. Chem.), Agr. (B. S.), mech. engin., civil engin., elect. engin., textile sci. and art (B. E.), elem., dyeing (B. S.).	courses in agr. and nature study (1 and 2 years), agr. (1 yr., agr. and dairying (6 weeks), winter, May school for agr. teachers (1 month), corn culture (1 week, January), farm drainage (1 week), agr. hist.
North Carolina.....	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh.....	D. H. Hill, A. M., LL. D.	Farm husb., power mach. (3 yrs. each), agr., commerce, dom. sci. mech. arts and manual training, general sci. (4 yrs.)	Farm husb., power mach. (3 yrs. each), agr., home econ. (3 yrs., high-school), agr., commerce, dom. sci. mech. arts and manual training for rural teachers (4 yrs.), nature study, el. agr., dom. sci. and manual training for rural teachers (4 yrs.), agr., steam engin. (winter, 10 weeks each), traction engin. (summer, 4 weeks), summer school for teachers, including agr., nature study, and home econ. (4 weeks), music.
North Dakota.....	The Agricultural and Mechanical College for the Colored Race.	Greensboro.....	J. B. Dudley, A. M., LL. D.	Agr., gen. sci., home econ., biol., mech. engin., civil engin., pharm., chem., chem. engin., education, vet. sci. (B. S.).	Agr. (B. S. Agr.) ed., hort., forestry, dom. sci., chem. engin., manual training, dhar. (B. S.), arts, philos. and sci. (B. A.), archi. (C. E. in Archi.), civil engin. (C. E.), ceramic engin. (Cer. E.), min. engin. (F. M.), elect. engin. (M. E. in E. E.), mech. engin. (M. E.), vet. med. (3 yrs., D. V. M.), law (3 yrs., LL. B.).
Ohio.....	Ohio State University	Columbus.....	W. O. Thompson, A. M., LL. D., D. D.	Agr., animal husb., hort., agron., dairy husb., mech. engin., archi., and civil engin., elect. engin., sci. and lit., dom. sci. and art, normal (B. S.).	Agri. (1 yr.), agr. and dairy (winter, 10 weeks), dairying (winter, 4 weeks), cool grading (3 weeks), ice-cream making (2 weeks), milk and cream testing (1 week), summer normal for teachers of agr. (6 weeks), reading course in agr. for teachers (2 yrs.), farmers' week, agr. and dom. sci. (1 week).
Oklahoma.....	Oklahoma Agricultural and Mechanical College.	Stillwater.....	J. H. Cornell, M. S.		

Agricultural and Normal University.	Langston.....	I. E. Page, A. M.	Clas. (B. A.), sci. (B. S.), normal (B. S. D.)	Normal, el. with required agr. (4 yrs. each), agr. (B. S. Agr.) elect. engin., mech. en-gin., archi. engin. (B. M. E.).
Oregon.....	Corvallis.....	W. J. Kerr, D. Sc.		Trade courses in carpentry, mach., blacksm., steam engin. (3 yrs.). Sec. agr., dom. sci. and art, commerce, for-estry, mech. arts (2 yrs.), phar. (2 yrs.), agron., animal husb., dairying, horst, for-est rangers, dom. sci., and art, mech. arts (winter, 4 weeks each), summerschool for teachers, including agr. and home econ. (6 weeks), farmers' week, music.
Pennsylvania.....	The Pennsylvania State College.	E. E. Sparks, Ph. D. L.L. D.	Classical, mod. lang. and lit., history and poli-tic. sci., philos. and ed., prep. to law, agr. chem., agron., animal husb., dairying, hort., bot., landscape gard., forestry, home econ., biol., chem., civilengin., elect. engin., elec. chem., engin., industr., chem., flour mill engin., industr., engin., math., archi. engin., mech. engin., mining engin., metal. engin., phys., prep. to med., sanitary engin., ind. arts., highway engin., rv. mech. engin., min. geol., manual training (B. S.).	Agron., animal husb., bot., chem., dom. sci., hort., phys., zool., ed., manual training, farm man., soils, rural econ., forestry, back., ent. (4-yr. courses, but no degrees conferred). Agr., mech. engin., civil engin., chem. engin., elect. engin., teachers' course in applied sci., home econ. (B. S.).
Porto Rico.....	University of Porto Rico.	E. M. Bainter		Normal nature study, el. agr., sewing, bot. zool. (18 weeks each), dom. sci., school gardening (1 yr. each).
Rhode Island.....	Rhode Island College of Agriculture and Mechanic Arts.	Howard Edwards, M. A., LL. D.		Agr. (2 yrs.), mech. arts (2 yrs.), dom. sci. (2 yrs.), poultry school (winter, 6 weeks), summer school for teachers et al. in el. agr., nature study, school gard., and dom. sci., farmers' week.
South Carolina.....	The Clemson Agricultural College of South Carolina.	W. M. Riggs, E. M. E., L.L. D.	Clemson College...	Agr., agr. and chem., agr. and animal husb., mech. and elect. engin., civil engin., chem., textile industr., archi., engin. (B. S.). Collegiate (B. A.), mech. (B. S.), agr. (B. Agr.).
South Dakota.....	Brookings.....	R. L. Slagle, A. M., Ph. D.	Orangeburg.....	Agr. home econ., general sci., mech. engin., elect. engin., civil engin., phar. (B. S.), phar. (2 yrs., Ph. G.).
				Prep., coml. sci., sec. agr. and home econ. (3 yrs.), 2 yrs. normal in home econ., music (2 courses, 3 yrs. each), steam en-gin. (3 months), creamery (3 months), agr. and home econ. (12 weeks), agr. (winter, 2 weeks), summer session for teachers, including agr. home econ., etc. (3 weeks), corrept. courses in agr., nature study, and home econ., art, secretarial (1 yr.).

Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.

State or Territory.	Name of institution.	Location.	President.	Four-year courses and degrees.	Collegiate courses of study (undergraduate).
Tennessee.....	University of Tennessee.	Knoxville.....	Brown Ayres, Ph. D., LL. D., D. C. L.	Lit. (B. A.), agr., home econ., sci., civil engin., mech. engin., elect. engin., mining engin., metal. engin., chem. engin. (B. S.), med. (M. D.), education (3 yrs. D. S., in Ed.), dental surgery (3 yrs. D. S., law (3 yrs., LL. B.), phar. (Ph. C.) 2 yrs.	El. agr. for negroes (4 yrs.), agr., prep. med. (2 yrs. each), agron., hort., animal husb., dairy husb., poultry husb., beekeeping home econ. (10 weeks, in succession 2 weeks each), summer school of agr. for teachers (6 weeks).
Texas.....	Agricultural and Mechanical College of Texas.	Prairie View State Normal and Industrial College.	R. T. Milner	Agr. (2 yrs.), textile engin. (2 yrs.), practical farmers' course (6 weeks), correspondence in agr., school of cotton classing (6 weeks).	Normal and indust., including agr., mech. arts, and dom. sci. (4 yrs.), mech. arts (3 yrs.), agr. and hort. (2 yrs.), dairying (2 yrs.), summer school.
Utah.....	Agricultural College of Utah.	Logan.....	E. L. Blackshear ¹	Agron., hort., animal husb., and dairying, home econ. ent., agr. engin., agr. chem., commerce, general sci. (B. S.).	Manual training in mech. arts (4 yrs.), manual training in home econ. (4 yrs.), high-commerce (4 yrs., winter) mech. arts (2 yrs., winter), agr., domestic sci. and mech. arts (8 weeks), forestry (12 weeks), summer school (6 weeks), farmers' round-up and housekeepers' comb. (2 weeks), music.
Vermont.....	University of Vermont and State Agricultural College.	Burlington.....	G. P. Benton, LL. D., D. D.	Agr. (winter, 5 weeks); farm dairying (4 weeks), summer school for teachers, including dom. sci. (6 weeks), farmers' week.	Agr. (winter, 5 weeks); farm dairying (4 weeks), summer school for teachers, including dom. sci. (6 weeks), farmers' week.
Virginia.....	The Virginia Agricultural and Mechanical College and Polytechnic Institute.	Blacksburg.....	P. B. Barringer, M. D., LL. D.	Agr., hort., applied chem., civil engin., mech. engin., applied chem., civil engin., engin., elect. engin., mining, chem. engin., agric. engin., metal, and metallurgy, applied geol., applied biology (B. S.).	Agr. (2 yrs.), farmers' winter course (1 month).
	The Hampton Normal and Agricultural Institute.	Hampton.....	H. B. Frissell, ¹ D. D., LL. D.		Academic (4 yrs.), trade (3 yrs.), pract. agr. (3 yrs.), Graduate: Agr. (1 yr.), home econ. (2 yrs.), matrons' course (2 yrs.), normal (2 yrs.), business (2 yrs.), library methods (2 yrs.), business (2 yrs.), summer session for teachers in agr., dom. sci., etc. (4 weeks).

Washington.....	State College of Washington.	E. A. Bryan, A. M., LL.D.	Math., civil engin., phys., hydro-elect., engr., domestic econ., phar., chem., bot., zool., econ., biol., agron., animal husb., and dairying, hort., forestry, vet. sci., econ., sci. and hist., elect. engin., mech., engin., mining engin. (B. S., B. A.), geol., Engl. lang. and lit., modern lang., Latin, education archi. (B. A.), ret. sci. (3 yrs., D. V. S.), phar. (2 yrs., Ph. G.), music (3 yrs., B. Mus.).	Gold and metal mining (2 yrs. each), el. sci. (3 yrs.), agr. (2 yrs.), 1 yr. course for forest rangers, artisans (1 yr. bookkeeping, sten. (1 yr. each) agr. (20 weeks), mining (12 weeks), dairying (8 weeks), summer science school for teachers (6 weeks), hort.
West Virginia.....	West Virginia University.	T. E. Hodges, A. M., D. Sc.	General culture (B. A., B. S.), mech. and elect. engin. (B. S., M. E.) civil engin. (B. S., C. E.) mining engin. (B. S., E. M.), agr. (B. S., Agr.) commerce (B. S. Com.), law (4 yrs. LL. B.).	Commerce (2 yrs.), agr., (4 yrs., 6 months each), agr., hort., animal husb., dairy, poultry culture (12 weeks), el. agr. and nature engin. for teachers (summer, 6 weeks), agr. (farmers' course, 2½ weeks), agr., short course (winter, 12 weeks for 2 yrs.), music (3 and 4 yrs., cert.), art (4 yrs., diploma), music (3 and 4 yrs., cert.), Normal agr., acad., mech., printing (4 yrs.), sewing, dressmaking, com 1, cooking, mil- linery (2 yrs.).
Wisconsin.....	University of Wisconsin.	Byrd Prillerman, A. M.	Sci. commerce, journalism (B. A.) normal (B. Ph.), sci. agr. for teachers (B. S. and B. A.) agr., civil engin., mining engin., mech. engin., elect. engin., applied electrochem., chem., chem. engin., pharm., home econ. (B. S.), music (Grad. in Mus.), law (3 yrs. prof., L.L. B.), pharm. (2 yrs., Ph. G.).	Agr. (2 yrs.), agr. (2 winter courses, 14 weeks each), dairy school (winter, 12 weeks), creamery (summer, 10 weeks), farmers' course (10 days, winter, summer school, including agr. and home econ. (6 weeks), spec. cheese and creamery, housekeepers', boys' corn and seed grain (1 week), housekeepers' conf., corresp. Prep., commerce (4 yrs.), summer school (6 weeks), music, corresp. courses.
Wyoming.....	University of Wyoming.	C. O. Merica, A. M., LL.D.	Liberal arts (B. A.), agr. home econ., engin. (B. S.), commerce (B. S. in Com.).	Principal.

General statistics of land-grant

State or Territory.	Date of establish- ment of in- stitution.	Date of estab- lish- ment of agri- cultural courses.	Faculty and staff.					
			College of agriculture and mechanic arts.					
			Interior instruction.			Agricultural extension department workers.	Full time.	Part time.
			Prepara- tory classes. ¹	Second- ary schools of agri- culture.	Collegiate and special classes.	Total. ²	Full time.	Part time.
1 Alabama.....	1872	1872			67	67	4	
2 Arizona.....	1891	1891	13		20	33	10	
3 Arkansas.....	1872	1872			4	4	3	9
4 California.....	1868	1868		20	88	101	2	25
5 Colorado.....	1877	1878		41	49	65	1	59
6 Connecticut.....	1881	1881	7	15	23	25		1
7 Delaware.....	1870	1870			13	13		4
8 Florida.....	1884	1884		2	18	20	2	15
9 Georgia.....	1872	1872			27	27	20	7
10 Hawaii.....	1907	1907			18	18		3
11 Idaho.....	1892	1892	2	20	35	50	2	16
12 Illinois.....	1867	1868			156	156	3	
13 Indiana.....	1874	1874			163	163	6	
14 Iowa.....	1869	1869			153	153	17	17
15 Kansas.....	1863	1874	7		131	138	14	27
16 Kentucky.....	1865	1880	5		70	70		
17 Louisiana.....	1877	1887		4	48	51	3	
18 Maine.....	1865	1868	13		80	91		13
19 Maryland.....	1859	1859	7		25	25	1	18
20 Massachusetts (Amherst).....	1867	1867			56	56	3	24
21 Massachusetts (Boston).....	1865				4 245	245		
22 Michigan.....	1855	1855			115	115	5	10
23 Minnesota.....	1869	1869		90	84	162	13	1
24 Mississippi.....	1880	1880	3		60	63	2	
25 Missouri (Columbia).....	1870	1870			67			40
26 Montana.....	1893	1893	15	15	33	40	1	14
27 Nebraska.....	1869	1869		42	46	49	3	32
28 Nevada.....	1873	1888	12		35	39		
29 New Hampshire.....	1866	1866		27	46	47		10
30 New Jersey.....	1864	1865	14		52	63		
31 New Mexico.....	1889	1890	3		40	43		1
32 New York.....	1865	1865			5 143	143		
33 North Carolina.....	1889	1889			54	54	3	
34 North Dakota.....	1890	1890	33	22	50	61	3	17
35 Ohio.....	1870	1873			195	195	16	7
36 Oklahoma.....	1891	1892	5	47	64	116	4	2
37 Oregon.....	1868	1888		(6)	108	108	1	4
38 Pennsylvania.....	1855	1859			197	197	2	
39 Porto Rico.....	1903	1904	12		22	34		
40 Rhode Island.....	1888	1890			31	31	3	
41 South Carolina.....	1889	1893	2		53	55	5	58
42 South Dakota.....	1881	1884	5	7	48	60	1	7
43 Tennessee.....	1794	1869	12		32	44		6
44 Texas.....	1871	1871			86	86	6	1
45 Utah.....	1888	1889		32	39	71	5	20
46 Vermont.....	1865	1885			21	21		
47 Virginia.....	1872	1872			62	62		
48 Washington.....	1892	1892	36		96	104	5	16
49 West Virginia.....	1867	1867			10	10	2	7
50 Wisconsin.....	1848	1866		33	164	164		23
51 Wyoming.....	1887	1891	3		27	27		1
Total.....			209	417	3,569	3,835	161	525

¹ Including schools of agriculture of high-school grade under the control of the institution.² Counting none twice.³ Including substations.⁴ Including 25 lecturers regularly appointed.

colleges for white students, 1912.

Faculty and staff.		Library.		Number of acres allotted to State under act of 1862.	Number of acres land grant still unsold.	Number of acres in farms and grounds.	Rates of interest on land-grant fund of 1862.	<i>Per cent.</i>
Experiment station officers. ³	Total, ²	Total for entire institution, counting none twice.	Number of volumes.	Number of pamphlets.				
54	76	76	25,000	3,500	240,000	325	8	1
12	43	43	18,000	5,000	.....	79	.....	2
17	23	174	20,000	19,000	150,000	160	8	3
60	66	130	247,400	65,000	150,000	1,309	6	4
26	80	80	40,000	50,000	90,000	1,818	6	5
32	33	33	12,000	1,000	180,000	958	5	6
13	11	17	18,900	2,500	90,000	227	6	7
17	36	51	13,000	4,500	90,000	589	6	8
8	27	27	38,100	10,500	270,000	987	7	9
	18	18	9,260	8,500	.....	90	.....	10
26	60	73	27,707	3,500	90,000	337	.....	11
70	239	543	212,700	23,000	480,000	700	5	12
52	196	196	27,000	5,000	390,000	280	5	13
40	226	226	35,850	41,000	204,000	1,175	6,7,8	14
61	86	165	40,916	20,000	82,313	751	5,5½,6,7	15
34	70	103	5,000	2,000	330,000	290	6	16
36	76	90	3,500	.....	210,000	724	4,5	17
23	117	117	48,000	.....	210,000	473	5	18
14	44	44	6,000	5,000	210,000	280	5,6	19
30	84	84	37,369	.....	360,000	545	5	20
	245	245	92,148	25,875	.....	.....	.....	21
29	44	44	36,079	.....	235,673	50,721	684	7
56	162	499	160,000	25,000	94,000	1,814	3,4,5	23
18	70	70	28,300	11,963	207,920	2,000	6	24
55	81	238	124,310	20,650	277,016	47,607	796	5
18	50	50	11,708	6,500	90,000	117,863	380	25
33	56	255	99,650	5,000	90,000	7,494	330	26
15	47	57	22,680	12,000	90,000	14	95	4
17	51	51	30,000	10,000	150,000	410	6	29
30	80	80	66,991	5,000	210,000	285	5	30
21	48	48	14,732	20,594	.....	435	.....	31
79	143	724	409,700	62,000	989,920	1,099	5	32
49	71	71	10,528	6,000	270,000	485	6	33
45	90	90	23,461	1,400	130,000	943	.....	34
57	228	273	116,728	10,000	630,000	439	6	35
17	132	132	15,943	80,000	250,000	1,000	.....	36
39	134	140	19,222	20,000	90,000	4,200	340	6
58	209	209	44,613	7 50,000	780,000	400	6	38
9	43	43	7,800	.....	.....	223	.....	39
14	49	49	19,210	7,000	120,000	169	3	40
19	64	64	16,295	9,000	180,000	1,744	6	41
20	61	61	15,120	5,500	160,000	560	.....	42
21	62	156	34,596	32,874	300,000	272	6	43
27	119	119	(*)	.....	180,000	2,416	6,7	44
26	74	74	21,276	25,273	200,000	22,992	124	45
18	32	110	85,871	34,920	150,000	338	6	46
29	80	80	18,950	33,650	300,000	408	6	47
32	123	146	31,182	6,700	90,000	65,931	486	48
16	34	99	46,000	2,500	150,000	130	6	49
78	164	581	185,079	60,000	240,000	160	1,280	4
13	30	44	31,000	.....	90,000	89,165	1,154	51
1,583	4,487	7,192	2,724,874	858,399	10,570,842	652,617	33,136	.....

⁵ Instruction in the first two years of these courses is mainly given in the College of Arts and Sciences.

⁶ Included in collegiate classes.

⁷ Estimated.

⁸ Library destroyed by fire May 27, 1912.

Graduates and students, by classes, at land-grant colleges for white students, 1912.

Nebraska.....	51	10	318	400	4,517	412	332	275	4	915	15	1,500	1,781	2,742	6,953	
Nevada.....	3	18	23	26	480	88	25	17	23	363	15	1,500	1,781	2,742	385	
New Hampshire.....	9	15	17	44	487	76	229	1	17	322	15	1,500	1,781	2,742	595	
New Jersey.....	25	25	17	66	867	162	378	4	128	672	15	1,500	1,781	2,742	672	
New Mexico.....	1	2	1	4	8	125	168	18	1	94	332	15	1,500	1,781	2,742	508
New York.....	96	235	14	490	821	12,973	1,987	1	451	223	2,650	21,000	2,025	483	3,198	
North Carolina (West Raleigh).....	14	32	8	6	52	621	426	10	114	37	32	619	300	300	1,219	
North Dakota.....	7	7	8	9	26	145	344	169	6	470	124	1,216	2,000	2,000	3,216	
Ohio.....	74	108	35	284	501	4,240	1,563	166	273	2,004	1,924	2,004	2,004	2,004	13,413	
Oklahoma (Stillwater).....	16	21	7	33	67	401	246	881	1	735	59	9,385	8,122	8,122	11,788	
Oregon.....	28	38	33	27	126	1,216	142	56	809	18	26	1,583	2,634	2,634	2,895	
Pennsylvania.....	26	207	3	35	271	1,971	411	2,042	37	136	55	2,079	9,000	600	347	
Porto Rico.....															399	
Rhode Island.....	2	8	3	4	17	197	190	190	3	18	27	24	248	120	120	
South Carolina.....	51	41	10	1	92	861	88	76	7	911	7	7	750	750	750	
South Dakota.....	11	10	1	9	31	488	83	123	184	390	154	154	154	154	154	
Tennessee.....	7	21	108	108	136	97	993	85	251	12	119	123	488	436	436	
Texas.....	25	21	1	8	21	97	325	419	883	12	14	129	1,190	1,041	649	
Utah.....	21	1	8	21	51	100	4,339	32	327	12	461	1,219	439	439	3,220	
Vermont.....	7	23	1	69	61	993	32	182	3	42	227	227	200	200	1,866	
Virginia.....	17	44	15	60	60	109	708	93	410	21	27	490	490	490	490	
Washington.....	14	20	15	66	88	1,443	10	22	321	102	27	543	543	543	767	
West Virginia.....	4	18	18	570	785	9,048	223	20	127	2	75	96	322	2,176	2,176	
Wisconsin.....	84	133	8	5	14	22	1,283	77	101	557	148	2,176	2,176	2,176	1,782	
Wyoming.....	3	5							20		20				22,706	
Total.....	1,200	2,260	427	4,494	8,370	103,736	3,226	4,022	30,532	1,326	1,308	9,537	4,749	53,764	33,149	
															32,685	
															242,954	

¹ Including schools of agriculture of high-school grade under the control of the institution.² Counting none twice.³ Not including farmers' institutes.⁴ This total includes not only those regularly enrolled in the institution, but in some cases many persons who have received limited instruction by correspondence.⁵ Including students in other departments.⁶ Music students.⁷ Including 33 students in college of engineering.⁸ Including 12 certificates in 2-year courses.

SSStudents, by courses, at land-grant colleges for white students in 1912.

	247	25	272	177	221	1,432	103	28
Oregon.....	214	74	376	29	751	210	3	769
Pennsylvania.....	10	37	37	43	35	6	6	975
Porto Rico.....	43	43	37	18	94	20	6	30
Rhode Island.....	72	72	43	23	352	24	7	129
South Carolina.....	363	363	72	2	111	7	7	155
South Dakota.....	363	363	363	470	151	1	123	804
Tennessee.....	132	132	132	62	377	4	4	207
Texas.....	76	76	76	9	106	69	19	270
Utah.....	91	9	100	8	40	2	2	1,129
Vermont.....	76	9	188	92	279	96	13	291
Virginia.....	94	76	9	36	54	35	26	164
Washington.....	36	457	457	134	90	48	35	408
West Virginia.....	12	12	12	9	792	48	96	15
Wisconsin.....	8,737	322	487	664	9,974	2,664	1,103	188
Wyoming.....	Total.....							

¹ Unless otherwise classified this number usually includes students in horticulture, forestry, and veterinary science.

² Counting none twice.

³ Three-year course.

⁴ Including 18 students in 4-year course.

⁵ Including students in dairying and animal husbandry.

⁶ Including 142 students in animal husbandry and 28 in dairy husbandry.

⁷ Including 118 students in sugar engineering (5 years).

⁸ Of this number 338 take 5-year course.

⁹ Including students in household economy.

¹⁰ About 300 students not yet classified.

General statistics and students at land-grant colleges for colored students in 1912.

State or Territory.	Date of establishment of agricultural institution.	Faculty.	Graduates.	Library.	Students by classes.						Other departments. Total.					
					College of agriculture and mechanic arts.			College of agriculture and mechanic arts.								
					Preparatory classes.	Collegiate and special courses.	Other departments. Total. ¹	In 1911-12 (num- ber).	Total number since organiza- tion.	Number of pamphlets.	Preparatory.	Post- grad- uate.	Colle- giate.	Short or sum- mer school.	Total.	
Alabama (Normal).....	1875	1882	3	5	8	17	1,384	9,200	900	182	175	270	2	245	245	
Arkansas (Pine Bluff).....	1875	1892	9	9	10	7	235	3,600	1,500	99	33	79	20	132	132	
Delaware (Dover).....	1890	1890	6	8	14	16	101	1,000	600	97	60	79	33	171	171	
Florida (Tallahassee).....	1887	1890	13	4	17	3	149	8,000	600	325	36	43	43	404	404	
Georgia (Savannah).....	1890	1890	7	11	18	244	291	2,000	8,000	86	648	568	568	568	568	
Kentucky (Frankfort).....	1887	1892	7	11	18	3	29	503	2,852	325	135	110	62	307	307	
Louisiana (New Orleans).....	1890	1890	8	6	14	7	3	12	2,200	5,401	104	218	50	62	206	206
Maryland (Princeton Ann.).....	1871	1878	13	6	13	7	312	138	2,200	1,000	118	136	46	46	136	136
Mississippi (Alcorn).....	1866	1866	2	2	17	4	15	371	2,000	900	472	114	114	114	586	586
Missouri (Jefferson City).....	1866	1866	2	2	31	32	564	6,000	6,000	48	170	231	231	401	401	
North Carolina (Greensboro).....	1891	1891	14	17	19	7	122	1,776	30,000	128	122	143	97	359	359	
Oklahoma (Langston).....	1897	1899	3	10	13	10	21	1,670	3,350	320	144	10	10	192	192	
South Carolina (Orangeburg).....	1896	1896	3	7	10	21	3	537	700	300	803	23	38	38	359	359
Texas (Prairie View).....	1868	1890	31	7	31	31	895	2,600	12,000	1,490	915	403	18	826	826	
Virginia (Hampton).....	1891	1892	4148	10	14	148	7	1,631	30,768	1,060	935	403	2	311	315	
West Virginia (Institute).....	1891	1891	280	107	351	123	131	7,458	74,901	65,011	5,335	5,317	20	64	1,051	1,051
														596	596	

¹ Counting none twice.² Normal classes.³ Certificate of proficiency.⁴ Including teachers in collegiate department.

Students, by courses, at land-grant colleges for colored students, in 1912.

Value of permanent funds and equipment of land-grant colleges, 1912.

State or Territory.	Land-grant fund of 1862	Other land-grant funds.	Other endowment funds.	Land grant of 1862 still unsold.	Farms and ground owned by the institution.	Buildings.	Scientific apparatus, machinery, and furniture.	Library.	Live stock.	Total.
Alabama (Auburn).....	\$233,500.00	\$31,000.00	.....	.....	\$9,000.00	\$355,000.00	\$77,733.54	\$77,000.00	\$5,076.35	\$808,319.89
.....	\$22,637.50	4,000.00	10,500.00	.....	20,000.00	90,000.00	28,000.00	4,800.00	175,337.50	.....
Arizona.....	150,000.00	.....	.....	.....	207,300.80	70,650.00	35,000.00	3,300.00	70,000.00	359,739.80
Arkansas (Fayetteville).....	164,594.31	10,500.00	125,000.00	19,021,673.12	28,000.00	150,000.00	150,000.00	40,000.00	6,000.00	109,000.00
California.....	732,233.14	154,712.27	3,466,629.02	\$11,818.27	.....	132,500.00	3,500.00	3,500.00	.....	14,137,065.82
Colorado.....	135,000.00	61,000.00	.....	225,000.00	355,900.00	330,000.00	93,000.00	39,102.00	10,138.00	1,052,234.31
Connecticut.....	100,000.00	50,000.00	150,000.00	150,000.00	90,000.00	28,000.00	28,000.00	20,000.00	18,000.00	707,000.00
Delaware (Newark).....	100,000.00	65,850.00	.....	160,000.00	271,000.00	75,000.00	15,000.00	10,000.00	393,000.00	.....
Delaware (Dover).....	100,000.00	65,850.00	.....	18,750.00	58,400.00	22,068.33	3,500.00	3,033.50	105,771.83	744,850.00
Florida (Tallahassee).....	153,000.00	.....	.....	.....	560,000.00	54,307.06	56,500.00	10,265.00	1,473,274.23	.....
Georgia (Athens).....	242,202.17	.....	.....	6,776.25	55,952.77	2,284.55	551.06	885.00	66,449.63	1,266,449.63
Georgia (Savannah).....	155,639.72	464,636.07	.....	100,000.00	69,000.00	31,632.00	20,250.00	5,603.00	226,455.00	.....
Hawaii.....	701,420.00	57,775.00	433,650.00	.....	119,107.65	35,200.00	13,234.61	1,940,663.05	1,940,663.05	.....
Idaho.....	647,401.53	.....	.....	460,000.00	2,035,500.00	1,010,073.61	426,000.00	11,470.00	4,653,445.14	.....
Indiana.....	340,000.00	100,000.00	120,000.00	100,000.00	1,083,500.00	295,000.00	55,000.00	10,000.00	1,913,500.00	.....
Iowa.....	86,777.97	.....	177,194.50	884,341.10	487,689.19	124,600.00	52,460.61	3,415,603.37	.....	3,415,603.37
Kansas.....	502,364.74	.....	9,607.50	259,500.00	748,329.00	255,376.00	67,532.70	1,892,00	1,892,00	1,892,00
Kentucky (Lexington).....	144,075.00	40,000.00	.....	290,000.00	500,000.00	40,000.00	5,000.00	5,000.00	1,024,075.00	1,024,075.00
Kentucky (Frankfort).....	182,313.00	136,000.00	.....	133,238.00	529,220.34	119,658.00	45,600.00	3,000.00	3,690.00	1,154,386.62
Louisiana (Baton Rouge).....	118,300.00	100,000.00	.....	11,000.00	49,160.00	9,532.40	4,200.00	1,365.00	1,160,484.43	1,160,484.43
Louisiana (New Orleans).....	115,946.00	.....	30,000.00	523,465.73	108,588.17	61,155.32	7,158.75	7,158.75	138,247.40	928,380.97
Maine.....	219,000.00	142,000.00	.....	5,000.00	340,000.00	70,000.00	8,500.00	12,000.00	576,446.00	.....
Maryland (College Park).....	989,939.99	76,000.00	.....	69,729.09	22,000.00	1,600,00	2,000.00	1,800.00	1,800.00	1,076,193.16
Maryland (Princess Anne).....	570,749.59	936,827.29	1,506,136.12	76,000.00	910,507.33	489,912.50	195,378.00	18,475.00	2,142,481.42	2,142,481.42
Massachusetts (Boston).....	988,575.00	1,412,12	250.00	98,000.00	528,556.00	1,356,575.00	473,835.00	7,000.00	2,010,850.00	2,010,850.00
Michigan.....	113,375.00	222,000.00	682,368.23	750,000.00	25,000.00	175,000.00	30,000.00	105,000.00	21,500.00	13,750.00
Minnesota.....	339,881.19	45,390.73	150,000.00	150,000.00	1,178,630.00	74,000.00	197,630.00	183,957.00	31,800.00	2,735,395.00
Mississippi (Agricultural College).....	215,000.00	215,000.00	150,000.00	150,000.00	550,000.00	975,000.00	462,636.25	110,000.00	34,200.00	1,066,501.92
Missouri (Columbia).....	107,363.73	48,590.00	80,000.00	80,000.00	360,000.00	80,000.00	80,000.00	9,000.00	1,472,000.00	1,472,000.00
Missouri (Jefferson City).....	116,000.00	726,727.92	.....	197,100.00	681,500.00	158,500.00	67,500.00	67,500.00	1,947,327.92	1,947,327.92
Nebraska.....	.....	.....	.....	107,900.00	106,000.00	91,000.00	39,400.00	39,400.00	6,187.00	350,487.00

New York.																									
North Carolina (West Raleigh)	688,576.12		8,384,829.38																						
North Carolina (Greensboro)	125,000.00																								
North Dakota.	1,047,697.69																								
Ohio.	524,176.50		150,373.07		275,455.15																				
Oklahoma (Stillwater)																									
Oklahoma (Langston).																									
Oregon.	196,519.00																								
Pennsylvania.	427,290.50		89,709.50																						
Porto Rico.																									
Rhode Island.																									
South Carolina (Clemson College).	95,900.00																								
South Carolina (Orangeburg).	5,754.00																								
South Dakota.																									
Tennessee.	400,000.00		136,738.12																						
Texas (College Station).	209,000.00		5,000.12		4,000.00																				
Texas (Prairie View).																									
Utah.																									
Vermont.	143,080.70																								
Virginia (Blacksburg).	135,000.00																								
Virginia (Hampton).	134,312.00																								
Virginia (Lynchburg).	172,156.37																								
Washington.	265,955.37		481,984.73																						
West Virginia (Morgantown).	115,104.17																								
West Virginia (Institute).	303,594.61		232,796.50		129,493.78																				
Wisconsin.	25,500.00		6,000.00																						
Wyoming.																									
Total.	13,205,898.64		3,368,558.07		18,507,188.37		5,165,209.81		22,023,266.60		14,459,391.12		12,594,728.25		5,630,297.92		796,369.66		125,757,483.34						

Including buildings, live stock, scientific apparatus, machinery, and furniture.

³ Including experiment station lands.

Including buildings, live stock

Revenue of land-grant colleges

	State or Territory.	Federal aid.			State aid.	
		Interest on land grant of 1862.	Interest on other land grants.	Appropriation acts of 1890 and 1907.	Interest on endowment or regular appropriations.	Appropriation for current expenses.
1	Alabama (Auburn).....	\$20,280.00		\$27,362.50	\$1,160.00	\$40,000.00
2	Alabama (Normal).....			22,637.50	4,000.00	
3	Arizona.....			50,000.00		38,470.44
4	Arkansas (Fayetteville).....	3,480.00		50,000.00		72,380.00
5	Arkansas (Pine Bluff).....			13,636.36		9,000.00
6	California.....	42,675.31	\$9,016.79	50,000.00	43,710.78	794,331.34
7	Colorado.....	13,679.00		50,000.00	85,843.11	30,580.20
8	Connecticut.....	6,750.00		50,000.00		25,000.00
9	Delaware (Newark).....	4,980.00		40,000.00		7,500.00
10	Delaware (Dover).....			10,000.00		
11	Florida (Gainesville).....	7,690.00	1,975.50	25,000.00		22,385.00
12	Florida (Tallahassee).....			25,000.00		7,500.00
13	Georgia (Athens).....			33,333.34		
14	Georgia (Savannah).....	16,954.14		16,666.66	800.00	
15	Hawaii.....			50,000.00		
16	Idaho.....	22,528.20	38,933.83	50,000.00		10,000.00
17	Illinois.....	32,464.32		50,000.00		575,000.00
18	Indiana.....	17,000.00		50,000.00		179,504.01
19	Iowa.....	35,018.73		50,000.00		
20	Kansas.....	24,481.91		50,000.00		
21	Kentucky (Lexington).....	8,644.50		42,750.00		135,000.00
22	Kentucky (Frankfort).....			7,250.00		13,000.00
23	Louisiana (Baton Rouge).....	9,115.69	5,440.00	27,685.84		100,000.00
24	Louisiana (New Orleans).....			22,314.16		10,000.00
25	Maine.....	5,915.00		50,000.00		
26	Maryland (College Park).....	5,797.18		50,000.00		16,000.00
27	Maryland (Princess Anne).....			823.51		
28	Massachusetts (Amherst).....	7,300.00		30,000.00		160,250.00
29	Massachusetts (Boston).....	5,306.68		16,666.67	29,000.00	
30	Michigan.....	70,265.32		50,000.00		228,800.00
31	Minnesota.....	23,861.89	33,667.28	50,000.00		285,792.71
32	Mississippi (Agricultural College).....	5,914.61	8,472.75	25,817.98		
33	Mississippi (Alcorn).....	6,814.50	5,777.77	24,182.02		10,800.00
34	Missouri (Columbia).....	17,994.00		46,875.00	45,455.00	495,393.00
35	Missouri (Jefferson City).....					
36	Montana.....	325,048.08		50,000.00		25,401.92
37	Nebraska.....	28,457.62	14,033.05	50,000.00	360,103.00	17,500.00
38	Nevada.....	3,914.09	1,519.72	50,000.00	41,039.02	88,065.00
39	New Hampshire.....	4,800.00		50,000.00		10,778.49
40	New Jersey.....	5,800.00		50,000.00		50,476.50
41	New Mexico.....		1,082.84	50,000.00		16,000.00
42	New York.....	34,428.80		50,000.00		297,425.77
43	North Carolina (West Raleigh).....	7,500.00		33,500.00		83,000.00
44	North Carolina (Greensboro).....			16,500.00		12,500.00
45	North Dakota.....	69,110.18		50,000.00	56,221.03	25,000.00
46	Ohio.....	31,450.59	7,739.97	50,000.00	397,526.57	57,853.02
47	Oklahoma (Stillwater).....	28,500.00		45,000.00		100,000.00
48	Oklahoma (Langston).....			5,000.00		36,000.00
49	Oregon.....	10,493.11		50,000.00		150,000.00
50	Pennsylvania.....	31,020.00		50,000.00		538,519.15
51	Porto Rico.....			50,000.00		61,665.00
52	Rhode Island.....	2,500.00		50,000.00		25,000.00
53	South Carolina (Clemson College).....	5,754.00		25,000.00		
54	South Carolina (Orangeburg).....	5,754.00		25,000.00		7,500.00
55	South Dakota.....		30,626.28	50,000.00		53,000.00
56	Tennessee.....	23,960.00	250.00	50,000.00		
57	Texas (College Station).....	6,500.00		50,000.00		199,697.16
58	Texas (Prairie View).....			12,500.00		32,000.00
59	Utah.....	11,813.96		50,000.00		65,838.77
60	Vermont.....	8,130.00		50,000.00		27,500.00
61	Virginia (Blacksburg).....	20,658.72		33,333.33		55,333.33
62	Virginia (Hampton).....	10,329.36		16,667.67	112,339.13	1,730.00
63	Washington.....	14,435.52	27,617.35	50,000.00		242,500.00
64	West Virginia (Morgantown).....	6,100.00		40,000.00		140,000.00
65	West Virginia (Institute).....			10,000.00		20,500.00
66	Wisconsin.....	12,717.94	12,007.45	50,000.00		1,106,029.00
67	Wyoming.....	7,500.56		50,000.00		80,911.16
	Total.....	831,587.51	198,160.58	2,520,502.54	1,177,197.64	6,937,410.97

¹ The total appropriation divided, \$15,000, going to the State station at New Haven.² Including appropriation for experiment station.³ Including interest on other land grants.

for year ended June 30, 1912.

State aid—continued.		Income from endowment other than Federal or State grants.	Fees and all other sources.			Total.	United States appropriations for experiment stations (acts of 1887 and 1906).	
Appropriation for Farmers' Institutes and extension work.	Appropriations for income of plant.		Student fees.	Private benefactions.	Miscellaneous.			
\$5,000.00		\$50.00	\$13,723.85		\$21,162.90	\$128,739.25	\$30,000.00	1
			700.33	\$15,000.00	20,080.51	62,418.34		2
			23,723.16		4,769.27	157,462.87	30,000.00	3
4,000.00			11,120.00	40,000.00	500.00	181,40.00	29,988.00	4
			135.00		22,771.36	45,542.72		5
15,000.00	267,362.23	91,357.71	155,515.82	566,028.38	164,590.19	2,199,588.55	30,000.00	6
2,500.00					38,873.27	221,475.58	30,000.00	7
2,500.00	33,000.00	7,260.00	45,331.00		47,968.09	217,809.09	115,000.00	8
4,500.00	10,000.00		9,963.85		3,250.00	80,193.85	30,000.00	9
			7,158.00	200.00	939.00	18,397.00		10
7,500.00	55,000.00		24,873.73	1,500.00	1,808.98	147,733.21	30,000.00	11
	15,000.00	500.00	12,000.00		900.00	60,900.00		12
		50,233.34		2,834.00	4,662.50	8,972.36	116,989.68	30,000.00
							17,466.66	13
			75,000.00		1,967.22	137,157.22	30,000.00	14
12,000.00	51,000.00		825.00		715.65	216,002.68	30,000.00	15
	1,207,400.00		241,114.05		91,295.41	2,197,273.78	29,938.04	16
27,500.00			64,353.56		115,871.18	454,228.75	30,000.00	17
50,000.00	48,247.75		83,787.92	2,362.99	75,091.52	344,508.91	30,000.00	18
35,000.00	79,000.00				115,823.54	304,305.45	30,000.00	19
280,000.00				40,000.00		306,394.50	30,000.00	20
			8,285.08		1,000.00	29,535.08		21
			15,602.70		40,566.41	198,410.64	30,000.00	22
					942.19	34,006.35		23
			101,500.00		39,614.60	238,330.93	30,000.00	24
6,000.00			32,565.39			110,362.57	30,000.00	25
			6,194.00	100.00	2,145.00	9,262.51		26
17,500.00	101,261.89		52,744.67		43,924.94	412,981.50	30,000.00	27
			348,894.14		121,335.71	521,203.20		28
			34,387.07		76,544.08	459,996.47	30,000.00	29
			793,986.94		43,652.83	1,537,376.67	30,000.00	30
11,250.00	41,900.00		97,332.09	250.00	64,768.52	255,705.95	30,000.00	31
	6,250.00		16,628.01		2,295.31	72,747.61		32
	96,700.00	800.00	76,408.27		31,143.32	810,768.59	30,000.00	33
3,125.00	3,000.00		8,750.00		16,000.00	30,875.00		34
10,000.00	21,000.00		13,741.00		12,241.83	157,432.83	30,000.00	35
17,500.00	199,000.00		74,789.16		4,103,492.18	864,875.01	30,000.00	36
	40,000.00	6,000.00	18,943.64	1,500.00	14,786.43	265,767.90	28,081.58	37
3,250.00	6,926.63	35,261.08	9,955.07		39,759.15	160,730.42	30,000.00	38
	15,136.00	35,783.34	27,937.39	40,050.52	59,643.04	284,886.79	30,000.00	39
			4,387.06		9,128.77	80,598.67	30,000.00	40
28,726.20	151,848.14	429,271.37	504,396.33	1,307,111.11	220,547.02	3,023,754.74	5 27,000.00	41
	50,000.00		65,171.92		56,318.52	298,490.44	30,000.00	42
	1,875.00		9,309.37		7,718.96	47,903.33		43
			38,702.68		12,658.01	251,631.90	30,000.00	44
33,567.19		16,520.19	133,813.74	787.50	54,684.39	785,943.16	30,000.00	45
		171,000.00	5,000.00		12,000.00	361,500.00	30,000.00	46
					201.50	41,201.50		47
2,500.00	273,500.00		22,389.32		43,936.27	552,818.70	30,000.00	48
			55,397.72		20,659.67	695,596.54	30,000.00	49
						111,665.00	30,000.00	50
2,000.00	3,000.00		34,811.25		12,542.31	129,853.56	30,090.00	51
			70,417.53	3,512.36	11,437.19	116,121.08	29,900.00	52
					1,107.47	48,361.47		53
	9,000.00				29,814.70	176,027.47	30,000.00	54
	4,000.00		8,586.49		15,528.57	182,036.64	30,000.00	55
51,139.29		1,498.55	39,410.23	250.00	10,000.00	618,504.42	30,000.00	56
9,000.00	196,250.00		147,057.26			80,500.00		57
	36,000.00							58
15,000.00	90,000.00		9,778.50		6,125.61	248,556.84	30,000.00	59
			30,067.66	63,501.48	56,462.31	259,725.73	30,000.00	60
4,350.00	6,000.00		78,260.12		64,374.00	265,309.50	28,635.51	61
			107,513.17	288,906.75	678.07	538,164.15		62
	(6)		20,748.00		32,155.09	387,455.96	30,000.00	63
5,000.00		17,789.80			20,000.00	228,889.80	29,250.00	64
	7,500.00	9,140.18			792.62	47,932.80		65
161,000.00	285,369.04	6,409.10	344,392.69	15,763.29	172,175.42	2,165,863.93	30,000.00	66
		3,250.01	3,093.30	500.00	6,183.98	151,439.01	28,850.59	67
626,407.68	4,647,746.97	660,779.00	3,654,050.11	2,384,947.71	2,296,065.41	25,967,130.45	1,476,643.72	

⁴ Including \$24,715 for investigation of plant and insect pests, production of hog-cholera serum, and other special activities.

⁵ The total appropriation divided, \$3,000 going to the State station at Geneva.

⁶ Included in current expenses.

Additions to equipment of land-grant colleges, 1912.

North Dakota.....	16,685.79	169,125.00	2,143.42	2,968.54	1,822.64	2,579.36	7,247.88	16,761.84
Ohio.....	30,000.00	1,032.15	23,491.54	20,140.00	16,548.94	2,146.00	2,842.00	248,137.27
Oklahoma (Stillwater).....			3,410.24	3,475.97				50,243.16
Oklahoma (Langston).....			1,000.00	56,532.40	35,083.93			1,800.00
Oregon.....	116,564.04	7,494.12						239,581.99
Pennsylvania.....	50,000.00							50,450.00
Porto Rico.....	63,000.00							63,000.00
Rhode Island.....			983.25	3,535.44	650.30	233.30		5,401.99
South Carolina (Clemson College).....	51,283.58	1,177.65		13,360.24		1,672.40		67,483.27
South Carolina (Orangeburg).....			4,000.00	400.00				
Tennessee.....	4,875.30	2,337.79		2,685.03	1,735.41	3,025.00	5,377.94	4,400.00
Texas (College Station).....	200,000.00			10,500.00	55,000.00	4,000.00	5,000.00	20,036.47
Texas (Prairie View).....	6,000.00							274,500.00
Utah.....	60,000.00	1,901.92		3,589.07	713.96	1,822.87		6,000.00
Vermont.....	60,044.22	7,661.95	3,184.74	1,4,459.30				72,176.25
Virginia (Blacksburg).....	164,589.02	25,000.00		2,2,500.00	3,000.00			75,350.21
Virginia (Hampton).....	31,843.48	34,566.61	6,498.46	37,500.00				7,750.00
Washington.....				20,958.40	10,184.13	2,928.35		198,658.02
West Virginia (Morgantown).....								116,241.60
West Virginia (Institute).....								
Wisconsin.....	6,350.39	229,955.99	25,295.67	39,104.83	4,339.08	5,199.28	8,757.00	8,757.00
Wyoming.....		11,907.96	2,890.14	12,049.78	1,070.95	1,081.13	24,680.22	33,005.46
Total.....	1,809,100.40	4,721,467.79	283,725.62	573,186.90	270,547.61	141,412.15	438,721.40	8,238,161.87

¹ Including machinery.² This amount includes money spent for textbooks.³ Including machinery and miscellaneous equipment.

Disbursements from the United States Treasury to the States and Territories of the appropriations in aid of colleges of agriculture and the mechanic arts under the acts of Congress approved Aug. 30, 1890, and Mar. 4, 1907.¹

For the fiscal year ending June 30—

State or Territory.	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900 ²	1908	1909	1910	1911	1913 ³
Alabama.....	\$15,000	\$16,000	\$17,000	\$18,000	\$19,000	\$20,000	\$21,000	\$22,000	\$23,000	\$24,000	\$25,000	\$30,000	\$35,000	\$40,000	\$45,000	\$50,000
Arizona.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
California.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Colorado.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Connecticut.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Delaware.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Florida.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Georgia.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Hawaii.....																
Idaho.....																
Illinois.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Indiana.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Iowa.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Kansas.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Kentucky.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Louisiana.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Maine.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Maryland.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Massachusetts.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Michigan.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Minnesota.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Mississippi.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Missouri.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Montana.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Nebraska.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Nevada.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
New Hampshire.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
New Jersey.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
New Mexico.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
New York.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
North Carolina.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
North Dakota.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Ohio.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Oklahoma.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Oregon.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Pennsylvania.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Porto Rico.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
Rhode Island.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
South Carolina.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000
South Dakota.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000	50,000

Tennessee.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Texas.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Utah.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Vermont.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Virginia.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Washington.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
West Virginia.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Wisconsin.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Wyoming.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000	35,000	40,000	45,000
Total.....	660,000	704,000	752,000	804,000	912,000	960,000	1,008,000	1,056,000	1,104,000	1,152,000	1,200,000	1,440,000	1,750,000	2,000,000	2,250,000
															2,500,000

¹ From the annual statement of the Commissioner of Education to the Secretary of the Interior, 1911.

² For each of the years ended June 30, 1901, 1902, 1903, 1904, 1905, 1906, and 1907 the sum of \$25,000 was paid to each of the 48 States and Territories included in this tabular statement, the total amount disbursed for each of the said years being \$1,200,000.

³ The appropriation for 1912 was the same as the appropriation for 1913.

STATISTICS OF AGRICULTURAL

General

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
1	Alabama (College)....	Auburn.....	J. F. Duggar.....	Feb. —, 1883	Feb. 24, 1888
2	Alabama (Canebrake).	Uniontown	L. H. Moore	Jan. 1, 1886	Apr. 1, 1888
3	Alabama.....	Tuskegee Institute.....	G. W. Carver.....	Feb. 15, 1897	.....
4	Arizona.....	Tucson.....	R. H. Forbes.....	.....	1889
5	Arkansas.....	Fayetteville.....	C. F. Adams.....	.....	1887
6	California.....	Berkeley.....	E. J. Wickson.....	1875	Mar. —, 1888
7	Colorado.....	Fort Collins.....	C. P. Gillette.....	.....	Feb. 29, 1888
8	Connecticut (State)...	New Haven.....	E. H. Jenkins.....	Oct. 1, 1875	May 18, 1887
9	Connecticut (Storrs)...	Storrs.....	L. A. Clinton.....	.....	May 18, 1887
10	Delaware.....	Newark.....	Harry Hayward.....	.....	Feb. 21, 1888
11	Florida.....	Gainesville.....	P. H. Rolfs.....	.....	1888
12	Georgia.....	Experiment.....	M. V. Calvin.....	Feb. 18, 1888	July 1, 1889
13	Idaho.....	Moscow.....	W. L. Carlyle.....	.....	Feb. 26, 1892
14	Illinois.....	Urbana.....	E. Davenport.....	.....	Mar. 21, 1888
15	Indiana.....	Lafayette.....	Arthur Goss.....	1885	Jan. —, 1888
16	Iowa.....	Ames.....	C. F. Curtiss.....	.....	Feb. 17, 1888

EXPERIMENT STATIONS.

statistics, 1912.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1912.		Number of names on mailing list.	Principal lines of work.	1
			Number.	Pages.			
32	13	20	15	417	23,000	Field experiments; cooperative experiments with farmers; horticulture; plant breeding; soil improvement; feeding experiments; entomology; diseases of plants and animals; analyses of fertilizers.	1
1	.....	.....	.....	.....	.....	Soil improvement; field experiments; plant breeding; diseases of plants.	2
21	19	21	3	.....	1,600	Field experiments; horticulture; plant breeding; diseases of plants; animal industry; poultry investigations; dairying.	3
12	1	10	3	198	6,500	Botany; field experiments; improvement of ranges; horticulture, including olive products and date-palm culture; sheep-breeding experiments; plant breeding; underground development; dry farming.	4
17	10	6	10	123	22,000	Chemistry; soil physics; field experiments; horticulture; plant breeding; diseases of plants; animal husbandry and pathology; feeding and breeding experiments; entomology; nursery inspection; dairying; poultry experiments.	5
60	25	12	22	814	11,928	Chemistry; soils; bacteriology; fertilizer control; field experiments; horticulture, viticulture, and zymology; botany; meteorology; animal husbandry; entomology; dairying; poultry culture; drainage and irrigation; silviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.	6
26	12	15	9	560	11,575	Chemistry; agronomy; horticulture; animal husbandry; horse breeding; animal diseases; potato diseases; alfalfa breeding; entomology; bacteriology; irrigation.	7
19	.....	5	7	568	9,000	Chemistry; analysis and inspection of fertilizers, foods, drugs, and feeding stuffs; inspection of Babcock test apparatus; nurseries; apiaries; diseases of plants; plant selection and breeding; seed testing; forestry; field experiments; entomology; investigation of vegetable proteids.	8
13	8	7	2	601	10,000	Dairy and soil bacteriology; field experiments; horticulture; feeding and breeding experiments; poultry experiments and diseases; dairying, including soft-cheese manufacture; embryology.	9
13	8	7	4	134	8,000	Chemistry; field experiments; horticulture; diseases of plants and animals; animal husbandry.	10
17	.....	1	5	47,640	17,000	Chemistry; soils; field experiments; horticulture; plant physiology; diseases of plants; feeding experiments; entomology; plant breeding.	11
8	.....	.....	5	140	12,200	Chemistry; field experiments; bacteriology; horticulture; plant breeding; plant and animal diseases; entomology; feeding experiments; dairying.	12
26	10	9	3	153	5,000	Chemistry; bacteriology; botany; field experiments; horticulture; plant breeding; plant pathology, and diseases; animal husbandry; irrigation; dairying; dry farming; wheat investigations; soils and soil physics.	13
70	48	8	18	400	23,000	Soil chemistry; soil physics; bacteriology; pot and field experiments; horticulture; plant breeding; animal husbandry; diseases of plants and animals; dairying.	14
52	14	15	21	828	45,556	Chemistry; soils; field experiments; feeding experiments; horticulture; plant breeding; diseases of plants and animals; entomology; dairying; feeding stuff and fertilizer control; agricultural extension work.	15
40	16	.....	11	276	20,000	Chemistry; botany; soils; field experiments; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; poultry investigations; entomology; dairying; rural engineering; good-roads investigations; bacteriology; veterinary science.	16

General statistics,

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
17	Kansas.....	Manhattan.....	E. H. Webster.....	.....	Feb. 8, 1888
18	Kentucky.....	Lexington.....	M. A. Scovell.....	Sept. —, 1885	Apr. —, 1888
19	Louisiana (Rice).....	Crowley.....	W. R. Dodson.....	.....
20	Louisiana (Sugar).....	New Orleans.....	do.....	Sept. —, 1885	.....
21	Louisiana (State).....	Baton Rouge.....	do.....	Apr. —, 1886	.....
22	Louisiana (North).....	Calhoun.....	W. R. Dodson.....	May —, 1887	.....
23	Maine.....	Orono.....	C. D. Woods.....	Mar. —, 1885	Oct. 1, 1887
24	Maryland.....	College Park.....	H. J. Patterson.....	1888	Apr. —, 1888
25	Massachusetts.....	Amherst.....	W. P. Brooks.....	1882	Mar. 2, 1888
26	Michigan.....	East Lansing.....	R. S. Shaw.....	.....	Feb. 26, 1888
27	Minnesota.....	St. Anthony Park, St. Paul.	A. F. Woods.....	Mar. 7, 1885	1888
28	Mississippi.....	Agricultural College.....	E. R. Lloyd.....	.....	Jan. 27, 1888
29	Missouri (College).....	Columbia.....	F. B. Mumford.....	.....	Jan. —, 1888
30	Missouri (Fruit).....	Mountain Grove.....	Paul Evans.....	Feb. 1, 1900	.....
31	Montana.....	Boseman.....	F. B. Linfield.....	.....	July 1, 1893
32	Nebraska.....	Lincoln.....	E. A. Burnett.....	Dec. 16, 1884	June 13, 1887

¹ In 1882 the State organized a station here and maintained it until June 18, 1885, when it was combined with the Hatch Station at the same place.

1912—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1912.		Number of names on mailing list.	Principal lines of work.
			Number.	Pages.		
61	43	37	16	626	20,976	Soils; inspection of feeding stuffs and fertilizer control; horticulture; plant breeding; forestry; field experiments; feeding and digesting experiments; milling and baking tests; correlation of characteristics of wheat; poultry experiments; diseases of animals; hog-cholera serum; entomology; dairying; extermination of prairie dogs and gophers; irrigation; veterinary experiments, diseases of the horse.
34	6	5	14	899	16,000	Chemistry; soils; bacteriology; inspection of fertilizers, foods, drugs, feeding stuffs, seeds, orchards, and nurseries; field experiments; horticulture; plant breeding; animal husbandry; diseases of plants and animals; entomology; apiculture; dairying; extension work.
2	7	2	7	8	14,000	Rice experiments; forage crops
23						Chemistry; bacteriology; soils; field experiments; sugar making; drainage.
4	23	20	1,296	8,500	•	Botany; bacteriology; inspection of fertilizers, feeding stuffs, and Paris green; horticulture; animal husbandry; diseases of animals; entomology; field experiments.
14						Chemistry; soils; fertilizers; field experiments; horticulture; feeding experiments; stock raising; poultry experiments; dairying.
30	8	13	7	595	23,306	Chemistry; botany; analysis and inspection of foods, drugs, insecticides, fungicides, fertilizers, concentrated commercial feeding stuffs, and agricultural seeds; calibration of creamery glassware; orcharding; plant pathology; biology; poultry breeding; plant breeding; entomology.
29	16	9	6	369	27,000	Chemistry; fertilizers; field experiments; horticulture; plant breeding; diseases of plants and animals; feeding experiments; animal breeding; poultry raising; entomology; dairying.
56	34	.....	28	420	45,000	Chemistry; meteorology; analysis and inspection of fertilizers and concentrated commercial feeding stuffs; inspection of creamery glassware and nurseries; pot, cylinder, and field experiments; horticulture; plant breeding; diseases of plants and animals; digestion and feeding experiments; entomology; dairying; effect of electricity on plant growth.
18	10	5	20	548	22,000	Chemistry; analysis and control of fertilizers; bacteriology; field experiments; horticulture; forestry; plant breeding; diseases of plants and animals; feeding and breeding experiments; poultry culture; entomology; stable hygiene.
52	42	20	19	461	11,000	Fertilizers; field experiments; horticulture; biology; plant breeding; animal husbandry; diseases of animals; poultry culture; entomology; dairying; agricultural engineering.
3	18	10	11	14	9,650	Chemistry; meteorology; botany; field experiments; dry farming; horticulture; feeding and breeding experiments; poultry experiments; veterinary science; entomology; dairying; irrigation and drainage.
33						Chemistry; botany; meteorology; soils; field experiments; horticulture; plant breeding; diseases of plants and animals; forestry; feeding and breeding experiments; entomology; dairying; irrigation.

General statistics,

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
33	Nevada.....	Reno.....	G. H. True.....		Dec. —, 1887
34	New Hampshire.....	Durham.....	J. C. Kendall.....	1886	Aug. 4, 1887
35	New Jersey (State)....	New Brunswick.....	J. G. Lipman.....	Mar. 10, 1880	
36	New Jersey (College).....	do.....	do.....		Apr. 26, 1888
37	New Mexico.....	Agricultural College.....	Luther Foster.....		Dec. 14, 1889
38	New York (State).....	Geneva.....	W. H. Jordan.....	Mar. —, 1882	
39	New York (Cornell)....	Ithaca.....	L. H. Bailey.....	1879	Apr. —, 1888
40	North Carolina (College).	West Raleigh.....	C. B. Williams.....	Mar. 12, 1877	Mar. 7, 1887 ✓
41	North Carolina (State).	Raleigh.....	B. W. Kilgore.....	1907	
42	North Dakota.....	Agricultural College.....	J. H. Worst.....		Mar. —, 1890
43	Ohio.....	Wooster.....	C. E. Thorne.....	Apr. 25, 1882	Apr. 2, 1888
44	Oklahoma.....	Stillwater.....	J. A. Wilson.....		Dec. 25, 1890
45	Oregon.....	Corvallis.....	J. Withycombe.....		July —, 1888
46	Pennsylvania.....	State College.....			June 30, 1887
47	Pennsylvania (Nutrition).	do.....	H. P. Armsby.....	1907	
48	Porto Rico.....				
49	Rhode Island.....	Kingston.....	H. J. Wheeler.....		July 30, 1888

1912—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1912.		Number of names on mailing list.	Principal lines of work.
			Number.	Pages.		
15	6	6	2	188	4,500	Chemistry; meteorology; botany; soils; field experiments; horticulture; plant breeding; forestry; animal feeding and breeding; plant diseases; veterinary science and bacteriology; zoology; entomology; irrigation.
17	12	10	10	174	16,901	Chemistry; botany; field experiments; horticulture; plant breeding; breeding experiments; entomology.
.
16	6	9	13	421	7,700	Chemistry; oyster culture; botany; analyses of fertilizers, foods, commercial feeding stuffs, and insecticides; pot, cylinder and field experiments; horticulture; floriculture; plant breeding; forestry; diseases of plants and animals; animal husbandry; dairy husbandry; poultry experiments; entomology; soil chemistry and bacteriology; soil surveys; irrigation; seed inspection.
14	.....	.....	.....	.....	.....	Chemistry; botany; soils; field crops; dry farming; horticulture; cactus investigations; nutrition; plant diseases; entomology; dairying; irrigation.
21	12	.....	5	333	5,429	Chemistry; bacteriology; meteorology; fertilizers; analysis and control of fertilizers; inspection of feeding stuffs, Paris green, and creamy glassware; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; soil studies.
33	.....	12	27	730	48,200	Chemistry; bacteriology; meteorology; fertilizers; analysis and control of fertilizers; inspection of feeding stuffs, Paris green, and creamy glassware; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; soil studies.
46	2	1	149	.....	28,000	Chemistry; soils; field experiments; farm crops; farm management; horticulture; plant breeding; plant physiology; diseases of plants; feeding and breeding experiments; poultry husbandry; entomology; dairying.
17	.....	6	3	.....	17,500	Chemistry; soils; field experiments; horticulture; nitrification experiments; diseases of plants and animals; animal husbandry; poultry experiments; dairying; tests of farm machinery; cottonseed feeding; toxic investigations; entomology investigations; plant breeding investigations; horticulture and agronomic experiments.
32	.....	7	12	.....	3,500	Chemistry; soils; field experiments; horticulture; diseases of animals; feeding experiments; entomology; fertilizer experiments and analyses; inspection of foods and stock feeds; cooperative demonstration work with farmers; farmers' institutes.
45	25	6	5	18,000	15,000	Chemistry; soils; botany; field experiments; plant breeding; horticulture; forestry; diseases of plants and animals; analysis of foods and spraying materials; seed inspection; inspection and analysis of paints, drugs, proprietary products, and feeding stuffs; feeding and breeding experiments; poultry experiments; milling and chemical tests of wheat; drainage; farm engineering; farm management.
57	.....	32	33	1,208	65,000	Chemistry; soils; field experiments; botany; horticulture; plant breeding; forestry; diseases of plants; feeding experiments; entomology; nutrition; farm management; dairying; climatology.
17	10	6	8	207	35,000	Chemistry; agronomy; field experiments; horticulture; forestry; botany; bacteriology; animal husbandry; dairying; veterinary science; entomology.
39	20	17	11	322	23,000	Chemistry; bacteriology; soils; fertilizers; field crops; horticulture; plant breeding and selection; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.
51	21	21	7	161	43,500	Chemistry; meteorology; fertilizers; horticulture; forestry; plant diseases; field experiments; feeding experiments; dairying; poultry experiments.
7	.....	.....	.....	.....	.....	Chemistry; meteorology; soils; analysis and inspection of fertilizers and feeding stuffs; field and pot experiments; horticulture; poultry diseases, poultry feeding, and pigeon and poultry breeding.
14	2	3	10	294	11,470	Chemistry; meteorology; soils; analysis and inspection of fertilizers and feeding stuffs; field and pot experiments; horticulture; poultry diseases, poultry feeding, and pigeon and poultry breeding.

General statistics,

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
50	South Carolina.....	Clemson College.....	J. N. Harper.....	.....	Jan. —, 1888
51	South Dakota.....	Brookings.....	J. W. Wilson .....	.....	Mar. 13, 1887
52	Tennessee.....	Knoxville.....	H. A. Morgan.....	June 8, 1882	Aug. 4, 1887
53	Texas.....	College Station.....	B. Youngblood.....	.....	Apr. 3, 1889
54	Utah.....	Logan.....	E. D. Ball.....	.....	1890
55	Vermont.....	Burlington.....	J. L. Hills.....	Nov. 24, 1886	Feb. 28, 1888
56	Virginia.....	Blacksburg.....	S. W. Fletcher.....	1888	1891
57	....do.....	Norfolk.....	T. C. Johnson.....	Feb. —, 1907	.....
58	Washington.....	Pullman.....	R. W. Thatcher.....	.....	1891
59	West Virginia.....	Morgantown.....	E. D. Sanderson.....	.....	June 11, 1888
60	Wisconsin.....	Madison.....	H. L. Russell.....	1883	1887
61	Wyoming.....	Laramie.....	G. H. Knight.....	.....	Mar. 1, 1891
	Total.....	.....	.....	.....	.....

1912—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1912.		Number of names on mailing list.	Principal lines of work.	
			Number.	Pages.			
19	10	9	11	293	20,300	Chemistry; soils; botany; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; dairying.	50
20	14	6	8	216	22,000	Chemistry; horticulture; field experiments; plant breeding; diseases of plants and animals; animal husbandry; dairying.	51
21	7	11	3	91	13,473	Chemistry; soil investigations; inspection of fertilizers; field experiments; horticulture; plant breeding; seeds; weeds; diseases of plants and animals; feeding experiments; entomology; dairying; apiculture.	52
27	5	.....	8	322	40,000	Chemistry; examination and comparison of commercial feeding stuffs and fertilizers; soils; field experiments; horticulture; plant breeding; feeding experiments; diseases of plants and animals and selection; entomology; cotton investigations; breeding experiments.	53
26	9	9	4	127	10,500	Chemistry of soils; field experiments; horticulture; diseases of plants; breeding and feeding experiments; poultry breeding; incubation; entomology; irrigation and drainage; arid farming.	54
18	7	7	8	632	13,000	Chemistry; botany; bacteriology; analysis and control of fertilizers and feeding stuffs; inspection of creamery glassware; horticulture; diseases of plants; feeding and breeding experiments; dairying.	55
21	.....	.....	.....	.....	.....	Chemistry; field experiments; horticulture; plant breeding; soil bacteriology; mycology; breeding and feeding experiments; diseases of animals; dairying.	56
8	.....	3	3	72	8,000	Field experiments; plant breeding; plant diseases; entomology.	57
32	15	11	15	225	16,123	Chemistry; plant physiology; bacteriology; soils; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; irrigation; dry farming; clearing logged-off lands.	58
16	10	.....	6	170	9,476	Chemistry; effect of pressure on bacteria; artificial fixation of atmospheric nitrogen; analysis and control of fertilizers; soils; farm crops; horticulture; diseases of plants and animals; inspection of orchards and nurseries; feeding and breeding experiments; poultry experiments; entomology; dairying.	59
78	78	12	40	1,265	20,000	Chemistry; bacteriology; soils; field experiments; agronomy; tobacco and cranberry culture; horticulture; plant breeding; plant pathology; breeding and feeding experiments; poultry experiments; veterinary science; entomology; dairying; irrigation and drainage; agricultural engineering; agricultural economics; home economics; extension.	60
13	9	.....	5	209	7,000	Chemistry; mycology; botany; meteorology; soils; range improvement; fertilizers; field experiments; plant selection; poisonous-plant investigations; breeding and feeding experiments; wool investigation; veterinary science; irrigation; parasitology; effects of alkali on structural and other material.	61
1,574	658	457	719	84,841	1,016,613		

Revenue and additions

	Station.	Federal.		State.	Individuals and communities.	Fees.	Farm products.	Miscellaneous.
		Hatch fund.	Adams fund.					
1	Alabama (College).	\$15,000.00	\$15,000.00	\$34,982.85	-----	-----	\$834.72	\$3,622.28
2	Alabama (Cane-brake).	-----	-----	-----	-----	-----	-----	-----
3	Alabama (Tuskegee).	-----	-----	-----	-----	-----	-----	-----
4	Arizona.	15,000.00	15,000.00	8,700.00	\$2,500.00	\$2,500.00	2,625.99	2,518.06
5	Arkansas.	215,000.00	15,000.00	39,200.00	525.00	-----	1,176.78	25,939.91
6	California.	15,000.00	15,000.00	125,275.00	-----	12,000.00	2,000.00	-----
7	Colorado.	15,000.00	15,000.00	11,250.00	30.00	-----	6,031.79	8,120.77
8	Connecticut (State)	7,500.00	7,500.00	18,500.00	14,019.88	11,500.00	386.99	370.08
9	Connecticut (Storrs).	7,500.00	7,500.00	3,875.00	-----	-----	-----	1,899.15
10	Delaware.	15,000.00	15,000.00	-----	-----	-----	3,060.27	-----
11	Florida.	15,000.00	15,000.00	-----	-----	-----	2,512.27	350.42
12	Georgia.	15,000.00	15,000.00	620.81	-----	-----	5,471.71	5,958.65
13	Idaho.	15,000.00	15,000.00	-----	-----	-----	8,325.86	198.58
14	Illinois.	3 15,000.00	4 15,000.00	168,000.00	-----	-----	25,655.65	12,384.68
15	Indiana.	15,000.00	15,000.00	-----	-----	-----	82,654.36	-----
16	Iowa.	15,000.00	15,000.00	55,000.00	-----	-----	12,326.44	14,198.00
17	Kansas.	15,000.00	15,000.00	61,500.00	-----	-----	1,778.36	-----
18	Kentucky.	15,000.00	15,000.00	38,613.89	-----	-----	10,474.81	96,276.63
19	Louisiana.	15,000.00	15,000.00	24,500.00	-----	24,010.00	4,578.04	3,062.12
20	Maine.	15,000.00	15,000.00	5,000.00	-----	17,000.00	8,804.45	1,364.10
21	Maryland.	15,000.00	15,000.00	14,000.00	-----	-----	8,605.76	919.00
22	Massachusetts.	15,000.00	15,000.00	16,875.00	-----	10,277.00	6,613.10	9,030.59
23	Michigan.	15,000.00	15,000.00	6,000.00	-----	5,420.00	-----	3,133.73
24	Minnesota.	15,000.00	15,000.00	103,726.08	-----	-----	-----	73,508.03
25	Mississippi.	15,000.00	15,000.00	33,150.00	-----	214.00	12,294.83	4,891.06
26	Missouri (College).	15,000.00	15,000.00	10,000.00	37,370.51	18,105.30	5,780.95	18,342.37
27	Missouri (Fruit).	-----	-----	-----	-----	-----	6,845.33	-----
28	Montana.	15,000.00	15,000.00	55,663.45	-----	-----	-----	51,003.21
29	Nebraska.	15,000.00	15,000.00	5 40,535.60	-----	-----	8,147.42	788.82
30	Nevada.	8 15,000.00	7 15,000.00	5,000.00	-----	-----	464.83	4,586.31
31	New Hampshire.	15,000.00	15,000.00	-----	94,041.96	-----	-----	-----
32	New Jersey (State).	-----	-----	-----	-----	673.89	-----	-----
33	New Jersey (College).	15,000.00	15,000.00	-----	-----	-----	-----	-----
34	New Mexico.	15,000.00	15,000.00	-----	280.17	75.25	1,805.81	1,768.71
35	New York (State).	1,500.00	1,500.00	113,509.05	-----	-----	-----	8,708.97
36	New York (Cornell).	13,500.00	13,500.00	-----	-----	-----	-----	-----
37	North Carolina (College).	15,000.00	15,000.00	-----	-----	-----	6,447.22	1,839.51
38	North Carolina (State).	-----	-----	-----	-----	-----	-----	-----
39	North Dakota.	15,000.00	15,000.00	13,243.35	-----	-----	-----	19,615.03
40	Ohio.	15,000.00	15,000.00	193,500.00	-----	-----	15,544.25	172,630.00
41	Oklahoma.	15,000.00	15,000.00	-----	-----	-----	-----	3,119.97
42	Oregon.	15,000.00	15,000.00	47,073.40	-----	-----	7,252.22	48,129.08
43	Pennsylvania (Nutrition).	15,000.00	15,000.00	5,000.00	-----	-----	25,908.94	3,087.40
44	Rhode Island.	15,000.00	15,000.00	-----	-----	-----	-----	4,703.32
45	South Carolina.	15,000.00	8 15,000.00	-----	-----	-----	2,233.54	4,701.57
46	South Dakota.	15,000.00	15,000.00	15,500.00	-----	-----	1,626.54	6,560.41
47	Tennessee.	15,000.00	15,000.00	-----	-----	-----	7,881.78	254.17
48	Texas.	15,000.00	15,000.00	55,000.00	-----	-----	1,921.38	2,668.69
49	Utah.	15,000.00	15,000.00	16,064.72	-----	-----	1,738.58	573.07
50	Vermont.	15,000.00	15,000.00	3,021.00	152.95	3,690.00	-----	9.89
51	Virginia.	15,000.00	9 15,000.00	9,433.32	-----	-----	4,001.68	320.88
52	Washington.	15,000.00	15,000.00	20,943.64	-----	699.00	408.01	326.39
53	West Virginia.	15,000.00	10 15,000.00	11 15,500.00	-----	12 12,920.03	8,180.94	5,490.71
54	Wisconsin.	15,000.00	15,000.00	15,000.00	-----	11,474.03	-----	9,000.00
55	Wyoming.	15,000.00	13 15,000.00	-----	-----	1,629.04	-----	-----
56	Total.	720,000.00	720,000.00	1,492,798.12	54,878.51	129,884.61	230,271.81	720,407.04

¹ Including all balances, except from Federal funds.² Including a balance of \$12 from previous year.³ Including a balance of \$49.20 from previous year.⁴ Including a balance of \$12.76 from previous year.⁵ Amount used by substations; as part of biennial appropriation ending Mar. 31, 1913.⁶ Including a balance of \$883.24 from previous year.⁷ Including a balance of \$1,035.18 from previous year.

to equipment, 1912.

Total.	Additions to equipment.							
	Buildings.	Library.	Apparatus.	Farm im-p-plements.	Live stock.	Miscella-neous. ¹	Total.	
	\$69,439.85	\$230.00	\$118.00	\$998.00	\$145.00	\$500.00	\$851.00	\$2,842.00
		75.00		150.00				325.00
48,844.05	950.00	50.97	391.18	999.11	877.75	1,034.87	4,312.88	4
96,841.69	4,150.00	464.24	446.74	1,480.53	2,000.00	2,457.00	10,998.51	5
169,275.00	59,693.01	1,022.87	3,577.10	7,510.45	9,711.17	6,014.03	87,528.62	6
55,432.56	1,790.69	310.21	1,078.06	1,153.57		613.80	4,946.33	7
59,776.95	58.00	943.25	225.78	54.00	200.00	1,139.30	2,620.33	8
20,774.15	65.65	29.41	248.70	31.85	231.85	1,054.82	1,662.28	9
33,060.27	3,000.00	420.08	720.11	507.45	1,522.75	800.00	6,970.39	10
32,862.69	1,000.00	390.00	522.52	213.68	260.00	400.00	2,786.20	11
42,051.17	1,672.99	426.88	451.89	382.05	220.50	19.75	3,174.06	12
38,524.44	798.91	73.44	1,851.03	1,025.88	850.00		4,599.26	13
236,040.33	5,199.44	106.86	1,278.25	6,152.16	7,799.99	1,141.74	21,678.44	14
112,654.36	32,931.80	809.96	1,631.13	1,408.67	13,465.99	155,855.08	206,102.63	15
111,524.44	605.81	98.85	894.37	1,268.75	2,611.40	562.62	6,041.80	16
93,278.36	125,000.00		1,500.00	2,000.00	500.00	1,000.00	130,000.00	17
175,365.33	15,000.54	2,212.14	1,568.57	733.57	555.00	1,983.05	22,052.87	18
86,150.16	8,360.35	244.85	1,015.03	863.84	1,235.95		11,720.02	19
62,168.55		808.68	512.52	3,265.98	2,171.83		6,849.01	20
53,524.76	1,450.12	863.56	253.99	1,647.41	1,960.00		6,175.08	21
72,795.69		124.88	772.68	21.06	700.00	55.00	1,673.22	22
44,553.73	3,275.00	1,103.37	2,179.61	223.86			6,781.84	23
207,234.11	536,190.00	21,991.22	17,276.90	6,398.88	9,994.00	20,468.94	612,319.94	24
80,549.89	8,000.00	200.00	1,000.00	1,050.00	3,760.00	560.00	14,510.00	25
119,599.13	49,182.10	20.83	2,266.29	788.68	6,932.69	1,491.72	60,682.31	26
								27
92,508.78	14,000.00		119.00	1,168.00	400.00	500.00	16,187.00	28
121,538.81	19,300.00	144.12	1,000.00	800.00	3,200.00		24,444.12	29
43,936.24	611.85	75.07	480.34	818.25	1,260.00		3,245.51	30
35,051.14	264.73	625.70	938.70	79.45	62.32	392.42	2,363.32	31
94,041.96	23,664.75	59.38	171.89	678.72		157.79	24,732.53	32
30,673.89								33
33,929.94	1,028.20	12.59	241.80	769.31	225.00		2,276.90	34
125,218.02		1,146.90	966.60	1,586.44	86.25		3,786.19	35
27,000.00	1,309.25	77.44		319.37	175.00	125.22	2,006.28	36
38,286.73	3,000.00	160.00	53.00	560.00	257.00	435.00	4,465.00	37
	1,500.00	250.00	500.00	300.00	1,800.00		4,350.00	38
62,858.38		2,143.42	2,968.54	1,822.64	2,579.36	7,247.88	16,761.84	39
411,674.25	21,637.05	1,441.00	2,740.87	3,802.64	4,134.41		33,755.97	40
33,119.97	417.95	112.28	324.73	471.60	259.75	464.20	2,050.51	41
132,454.70	1,331.19	746.79	1,817.88	2,409.72	4,208.95	201.20	10,715.73	42
63,996.34	500.00	355.00	1,108.76	738.64	902.25		3,604.65	43
	125.00	274.53	842.36	974.00	389.00		2,604.89	44
34,703.32	125.98	615.39	308.69	61.77	247.75	499.81	1,859.39	45
36,935.11	829.01	176.11	559.14	565.69	440.00		2,569.95	46
53,686.95	7,200.00	225.00	700.00	360.00		250.00	8,735.00	47
38,135.95	15,368.15	442.25	1,150.25	830.74	3,025.00	938.25	21,754.64	48
89,590.07	7,784.57	417.08	1,118.02	6,940.59	3,961.33	206.07	20,427.66	49
48,376.37	659.72	153.63	411.31	1,308.31	148.00	837.29	3,518.26	50
36,873.84	1,581.27	380.29	804.97	415.36	118.25		3,300.14	51
43,755.88		63.64	50.00	274.86		500.00	888.50	52
52,377.04	1,920.00	215.00	2,089.00	526.00	1,150.00		5,900.00	53
68,091.68	1,266.06	1,038.79	3,784.15	582.24	55.00		6,726.24	54
65,474.03	18,476.00	1,000.00	2,737.00	1,390.00	2,484.00	4,712.00	30,799.00	55
31,629.04	1,011.33	103.22	845.28	628.93	145.00	311.94	3,045.70	56
4,068,240.09	1,003,516.47	45,462.83	71,492.73	70,659.64	99,774.49	215,221.79	1,506,127.95	

⁸ Including a balance of \$100 from previous year.

⁹ Including a balance of \$1,364.27 from previous year.

¹⁰ Including a balance of \$750 from previous year.

¹¹ An additional sum is included in the annual appropriation for the university and station, but the amount is not ascertainable.

¹² Revenue from fertilizers.

¹³ Including a balance of \$1,149.41 from previous year.

Expenditures from United States appropriation of Mar. 2, 1887, for the agricultural experiment stations for the year ended June 30, 1912.

Station.	Classified expenditures.								
	Amount of appropriation.	Salaries.	Labor.	Publications.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.
Alabama.....	\$15,000.00	\$7,645.24	\$1,463.67	\$429.15	\$829.31	\$251.47	\$421.51	\$304.79	\$481.54
Arizona.....	15,000.00	6,692.49	2,456.43	737.37	802.01	128.69	87.63	566.93	566.93
Arkansas.....	15,000.00	7,257.85	1,357.76	872.00	614.53	304.18	414.67	19.45	660.45
California.....	15,000.00	6,487.56	6,003.64	198.19	525.60	198.55	136.15	441.09	150.06
Colorado.....	15,000.00	9,132.70	344.88	2,200.72	123.84	128.38	5.40	545.18	545.18
Connecticut (State).	7,500.00	6,753.25	200.00	173.65	69.26	25.00	42.00	170.83	63.92
Delaware.....	15,000.00	6,338.48	4,937.46	508.76	314.28	232.38	248.69	5.59	634.34
Florida.....	15,000.00	6,688.37	2,027.92	350.34	375.47	171.13	53.27	25.83	624.37
Georgia.....	15,000.00	5,750.00	3,476.12	918.80	249.83	190.43	53.27	1.00	624.37
Idaho.....	15,000.00	5,259.55	2,066.44	610.00	677.11	130.02	494.76	165.82	481.79
Illinois.....	15,000.00	7,620.00	2,124.88	800.00	1,886.90	114.23	98.00	114.23	98.00
Indiana.....	15,000.00	10,744.94	1,622.45	183.70	216.85	26.36	169.45	8.20	176.21
Iowa.....	15,000.00	7,000.00	1,586.32	1,139.32	473.87	169.68	159.62	1,017.20	1,017.20
Kansas.....	15,000.00	9,483.00	3,172.55	16.73	36.47	48.36	15.53	387.30	185.89
Kentucky.....	15,000.00	13,497.51	3,172.55	366.74	198.82	292.09	129.85	129.85	129.85
Louisiana.....	15,000.00	3,249.85	3,610.30	581.25	37.10	1.70	1.70	148.38	148.38
Maine.....	15,000.00	5,108.71	2,280.37	13.00	468.37	331.07	383.40	52.15	317.56
Maryland.....	15,000.00	6,680.95	2,872.19	192.13	6.75	375.76	119.60	91.68	661.28
Massachusetts.....	15,000.00	8,908.04	2,688.46	261.38	125.10	85.25	123.67	70.84	590.56
Michigan.....	15,000.00	8,520.70	2,188.66	53.55	214.42	2.46	74.46	29.07	342.66
Minnesota.....	15,000.00	14,833.35	9,956.56	86.24	46.56	23.87	23.87	1.00	988.14
Mississippi.....	15,000.00	6,842.81	2,368.23	43.60	332.23	191.38	114.31	55.45	195.52
Missouri.....	15,000.00	8,678.06	4,090.08	434.60	751.45	127.93	78.88	16.50	266.32
Montana.....	15,000.00	11,150.00	1,408.40	606.36	498.35	61.30	43.93	140.77	249.30
Nebraska.....	15,000.00	8,086.70	3,338.58	1,982.84	642.34	507.33	279.98	667.95	44.51
Nevada.....	15,000.00	7,476.88	1,747.30	322.59	125.10	77.24	708.96	81.38	329.43
New Hampshire.....	15,000.00	8,146.22	1,665.33	669.37	463.34	77.24	227.62	105.21	213.48
New Jersey.....	15,000.00	10,191.99	3,493.48	943.99	432.27	318.29	1.00	338.75	338.75
New Mexico.....	15,000.00	7,521.66	3,389.28	829.67	1,166.30	62.08	69.32	77.54	498.06
New York (State).	13,500.00	6,588.31	2,987.88	698.05	467.12	156.60	79.90	13.47	670.33
New York (Cornell).	15,000.00	5,321.58	2,689.29	500.00	23.00	500.00	4.70	4.70	64.12
North Carolina.....	15,000.00	9,849.00	3,634.32	643.96	572.57	71.35	46.62	137.78	441.22
Ohio.....	15,000.00	13,046.78	4,444.80	644.51	162.09	136.84	187.39	241.93	63.77
Oklahoma.....	15,000.00	9,734.86	2,064.15	1,933.61	119.28	1.00	1.00	1.00	14.13
Oregon.....	15,000.00	8,251.66	1,933.61	1,933.61	1,527.04	268.71	268.71	482.48	231.06
Pennsylvania.....	15,000.00	8,794.09	2,620.72	3,02	1,527.04	268.71	268.71	482.48	14.13
Rhode Island.....	15,000.00	8,794.09	2,620.72	3,02	1,527.04	268.71	268.71	482.48	231.06

Station.	Fertilizers,	Feeding stuffs.	Library.	Tools, im- plements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
South Carolina.....	15,000.00	8,008.36	2,842.25	813.88	276.71	70.86	73.95	103.59	447.17		
South Dakota.....	15,000.00	7,666.67	1,561.62	1,343.09	350.23	70.05	2.70	205.08			76.04
Tennessee.....	15,000.00	8,940.00	2,466.45	966.28	350.33	71.20	386.24	79.98	342.32		
Texas.....	15,000.00	7,756.83	2,005.75	639.07	587.53	191.18	27.05	80.58	61.94		
Utah.....	15,000.00	8,267.87	898.82	105.82	823.44	16.64	25.44	330.64	330.64		
Vermont.....	15,000.00	8,330.93	2,038.21	41.22	368.43	30.15	943.40	278.72	186.72		
Virginia.....	15,000.00	8,502.36	2,758.17	905.07	450.16	165.22	63.96	445.93			
Washington.....	15,000.00	6,904.43	2,657.15	1,277.72	664.76	133.76	87.70	575.24	205.72		
West Virginia.....	15,000.00	11,655.74	527.50	261.51	16.48	171.40	214.69	103.00			
Wisconsin.....	15,000.00	9,173.00	3,476.66	1,362.38	345.75	174.34	586.26	92.25	110.09		
Wyoming.....	15,000.00	6,750.00	2,091.12	1,362.38	345.75	174.34	80.87	87.87	385.03		
Total.....	720,000.00	409,247.33	112,900.62	26,946.81	19,724.19	5,916.61	8,403.70	5,837.18	17,663.74		

Classified expenditures.

Expenditures from United States appropriation of Mar. 2, 1887, for the agricultural experiment stations for the year ended June 30, 1912—Contd.

Classified expenditures.

Station.	Fertilizers.	Feeding stuffs.	Library.	Tools, im- plements, machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances,
Nebraska.....	\$542.81	926.72	\$4.80	\$108.45	\$239.25	\$228.52	\$256.64	\$256.27	\$25.00	73.00	.....
Nevada.....	215.32	607.87	177.09	145.12	302.22	32.65	323.88	322.65	25.75	340.31	\$254.94
New Hampshire.....	\$242.35	574.97	108.12	108.12	177.19	1.75	47.60	410.75	628.10	711.47	536.39
New Jersey.....	173.00	403.86	.....	.....	.....	.....	.....	248.25	25.00	.....	.....
New Mexico.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New York (State).....	30.50	50.00	11.10	228.61	83.35	.....	175.00	132.27	25.00	666.63	.....
New York (Cornell).....	1,132.21	2,245.97	26.29	721.79	90.66	.....	213.40	396.39	25.00	750.00	.....
North Carolina.....	29.30	.....	.....	119.00	342.66	225.78	.....	39.05	25.00	124.07	.....
Ohio.....	.....	.....	.....	.....	.....	.....	.....	94.65	25.00	744.81	.....
Oklahoma.....	1,542.48	265.65	174.38	184.30	434.40	5.43	138.00	103.43	74.59	87.90	.....
Oregon.....	13.00	497.88	92.21	564.85	241.70	56.65	150.22	1,474.06	36.05	25.00	61.16
Pennsylvania.....	258.80	501.72	82.11	284.11	45.00	73.67	74.86	75.34	112.97	.....	125.80
Rhode Island.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	475.41
South Carolina.....	.....	.....	.....	.....	.....	.....	.....	127.35	25.00	537.90	.....
South Dakota.....	65.06	810.38	165.79	360.40	264.18	346.95	221.35	236.10	25.00	549.31	.....
Tennessee.....	116.90	561.22	173.95	35.89	242.46	19.52	85.70	25.00	25.00	136.56	.....
Texas.....	119.95	484.85	580.73	619.65	303.77	39.79	93.98	447.35	25.00	114.98	.....
Utah.....	99.75	303.00	114.78	280.07	704.68	228.95	28.00	213.80	.....	306.33	.....
Vermont.....	68.40	1,064.21	284.78	77.17	84.17	69.26	.....	348.41	36.77	749.04	.....
Virginia.....	93.95	378.77	318.76	101.38	.....	109.31	74.53	425.09	45.00	51.24	\$12.10
Washington.....	60.25	203.10	22.90	682.24	751.93	10.50	665.81	50.00	50.00	.....	.....
West Virginia.....	234.36	165.90	63.99	1,310.26	129.94	106.46	106.46	25.00	25.00	10.77	.....
Wisconsin.....	855.14	292.06	.....	.....	527.76	34.50	88.43	280.24	25.00	139.16	.....
Wyoming.....	1.95	2,115.40	12.00	280.73	281.34	.....	.....	.....	.....	.....	.....
Total.....	7,002.65	33,984.76	9,281.50	8,473.51	9,037.31	10,332.53	10,787.98	1,758.66	14,384.41	459.20	.....

Disbursements from the United States Treasury to the States and Territories for Agricultural Experiment Stations under the acts of Congress approved Mar. 2, 1887, and Mar. 16, 1906.

State or Territory.	Hatch Act.		Adams Act.	
	1888-1911	1912	1906-1911	1912
Alabama.....	\$359,199.34	\$15,000.00	\$56,619.89	\$15,000.00
Arizona.....	324,803.15	15,000.00	60,000.00	15,000.00
Arkansas.....	358,163.12	14,988.00	60,000.00	15,000.00
California.....	360,000.00	15,000.00	59,926.84	15,000.00
Colorado.....	359,718.82	15,000.00	58,638.93	15,000.00
Connecticut.....	360,000.00	15,000.00	60,000.00	15,000.00
Dakota Territory.....	56,250.00			
Delaware.....	359,382.87	15,000.00	57,050.12	15,000.00
Florida.....	359,966.11	14,999.95	59,996.19	14,999.87
Georgia.....	359,981.55	15,000.00	60,000.00	14,720.50
Idaho.....	284,824.13	15,000.00	55,842.22	15,000.00
Illinois.....	360,000.00	14,564.95	59,864.38	14,987.24
Indiana.....	359,991.19	15,000.00	55,000.00	15,000.00
Iowa.....	360,000.00	15,000.00	60,000.00	15,000.00
Kansas.....	360,000.00	15,000.00	60,000.00	15,000.00
Kentucky.....	359,996.57	15,000.00	60,000.00	15,000.00
Louisiana.....	360,000.00	15,000.00	60,000.00	15,000.00
Maine.....	359,999.62	15,000.00	60,000.00	15,000.00
Maryland.....	359,967.40	15,000.00	59,763.99	15,000.00
Massachusetts.....	359,617.70	15,000.00	60,000.00	15,000.00
Michigan.....	359,676.10	15,000.00	56,341.20	15,000.00
Minnesota.....	360,000.00	15,000.00	59,345.74	15,000.00
Mississippi.....	360,000.00	15,000.00	60,000.00	15,000.00
Missouri.....	355,097.24	15,000.00	60,000.00	15,000.00
Montana.....	270,000.00	15,000.00	57,417.04	15,000.00
Nebraska.....	359,932.16	15,000.00	60,000.00	15,000.00
Nevada.....	359,939.32	15,000.00	59,663.58	15,000.00
New Hampshire.....	360,000.00	15,000.00	60,000.00	15,000.00
New Jersey.....	359,961.97	15,000.00	59,558.78	15,000.00
New Mexico.....	324,998.90	15,000.00	60,000.00	15,000.00
New York.....	359,860.54	15,000.00	59,880.85	15,000.00
North Carolina.....	360,000.00	15,000.00	60,000.00	15,000.00
North Dakota.....	301,778.34	15,000.00	60,000.00	15,000.00
Ohio.....	360,000.00	15,000.00	58,514.02	15,000.00
Oklahoma.....	299,270.80	15,000.00	54,324.74	15,000.00
Oregon.....	345,156.64	15,000.00	55,000.00	15,000.00
Pennsylvania.....	359,967.43	15,000.00	59,995.41	15,000.00
Rhode Island.....	360,000.00	15,000.00	57,464.20	15,000.00
South Carolina.....	359,542.15	15,000.00	58,460.12	15,000.00
South Dakota.....	303,250.00	15,000.00	55,000.00	15,000.00
Tennessee.....	360,000.00	15,000.00	60,000.00	15,000.00
Texas.....	360,000.00	15,000.00	57,876.91	14,715.35
Utah.....	225,000.00	15,000.00	59,821.94	15,000.00
Vermont.....	360,000.00	15,000.00	60,000.00	15,000.00
Virginia.....	358,741.58	14,087.90	59,951.95	14,997.91
Washington.....	299,726.75	15,000.00	56,080.11	15,000.00
West Virginia.....	359,968.71	15,000.00	57,859.12	15,000.00
Wisconsin.....	360,000.00	15,000.00	60,000.00	15,000.00
Wyoming.....	345,000.00	15,000.00	60,000.00	15,000.00
Total.....	6,688,640.20	718,850.80	2,825,258.27	719,420.87

Expenditures from United States appropriation of Mar. 16, 1906, for

	Station.	Amount of appropriation.	Classified expenditures.							
			Salaries.	Labor.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.	Fertilizers.
1	Alabama.....	\$15,000.00	\$9,967.49	\$2,161.68	\$168.53	\$182.78	\$183.04	\$514.42	\$316.39	\$146.70
2	Arizona.....	15,000.00	11,899.89	1,727.74	77.37	43.91	1.65	141.86	110.58	91.74
3	Arkansas.....	15,000.00	10,341.05	1,203.04	30.89	104.80	133.95	384.48	399.52	25.00
4	California.....	15,000.00 ¹	7,110.83	2,369.07	205.80	79.87	144.05	1,266.59	218.53	30.85
5	Colorado.....	15,000.00	11,494.12	226.98	113.79	213.83	-----	505.31	203.86	-----
6	Connecticut (State).	7,500.00	4,671.41	982.43	84.22	62.34	429.11	689.71	162.48	17.03
7	Connecticut (Storrs).	7,500.00	5,039.06	825.29	91.47	-----	35.29	165.15	659.99	6.50
8	Delaware.....	15,000.00	10,505.51	933.59	12.05	32.49	162.93	553.12	325.96	105.00
9	Florida.....	15,000.00	11,661.26	750.87	52.29	169.09	59.45	392.10	361.23	9.00
10	Georgia.....	15,000.00	9,450.00	1,529.95	182.00	77.06	174.03	181.86	138.22	200.14
11	Idaho.....	15,000.00	9,972.47	1,137.65	46.42	415.33	350.83	485.11	477.30	-----
12	Illinois.....	15,000.00	10,719.77	3,053.39	221.00	180.56	-----	84.44	46.09	-----
13	Indiana.....	15,000.00	11,193.18	281.76	42.53	14.09	25.80	202.50	473.16	-----
14	Iowa.....	15,000.00	9,024.49	2,391.68	28.91	44.78	105.48	924.98	465.96	-----
15	Kansas.....	15,000.00	5,083.40	4,617.82	61.72	238.01	18.66	559.29	577.40	-----
16	Kentucky.....	15,000.00	14,353.59	-----	9.00	-----	-----	122.97	5.00	-----
17	Louisiana.....	15,000.00	12,188.84	564.56	36.63	102.44	302.09	208.94	97.57	-----
18	Maine.....	15,000.00	13,181.92	112.94	22.22	73.06	134.15	.30	444.05	57.77
19	Maryland.....	15,000.00	10,415.69	264.75	20.25	-----	525.69	386.88	220.39	-----
20	Massachusetts.....	15,000.00	12,650.33	836.74	53.47	22.82	71.76	167.75	323.57	71.25
21	Michigan.....	15,000.00	11,086.16	920.62	11.86	82.31	-----	957.96	192.03	5.72
22	Minnesota.....	15,000.00	12,288.54	1,226.42	65.20	2.88	-----	210.28	53.84	-----
23	Mississippi.....	15,000.00	4,094.20	4,304.33	6.19	285.50	2.06	-----	474.12	-----
24	Missouri.....	15,000.00	7,119.03	1,779.66	16.10	-----	85.69	1,578.34	324.35	34.58
25	Montana.....	15,000.00	10,840.00	1,226.93	67.71	96.63	11.15	506.32	255.86	-----
26	Nebraska.....	15,000.00	10,241.80	1,730.84	1.23	108.07	-----	533.35	678.76	-----
27	Nevada.....	15,000.00	12,351.31	155.50	67.02	172.57	85.50	65.61	576.67	-----
28	New Hampshire.....	15,000.00	9,349.19	2,989.18	64.35	56.90	-----	146.08	307.87	192.67
29	New Jersey.....	15,000.00	10,538.34	1,082.03	27.34	51.50	179.42	384.74	475.61	167.20
30	New Mexico.....	15,000.00	9,380.42	2,068.58	87.54	307.77	153.46	774.10	464.11	-----
31	New York (State)	1,500.00	1,500.00	-----	-----	-----	-----	-----	-----	-----
32	New York (Cornell).	13,500.00	9,231.06	2,689.61	160.86	20.19	-----	401.42	108.31	2.00
33	North Carolina.....	15,000.00	11,248.47	1,241.43	227.60	65.95	33.79	251.48	127.07	217.81
34	North Dakota.....	15,000.00	10,523.02	1,515.05	13.68	41.51	-----	502.76	247.19	14.35
35	Ohio.....	15,000.00	12,778.34	350.65	53.50	-----	-----	687.93	-----	-----
36	Oklahoma.....	15,000.00	9,407.28	2,398.37	2.75	247.61	130.84	320.16	301.01	-----
37	Oregon.....	15,000.00	10,711.29	460.38	9.00	97.78	79.18	773.90	259.40	-----
38	Pennsylvania.....	15,000.00	9,458.91	1,047.71	14.42	552.18	119.52	655.82	236.04	1,143.22
39	Rhode Island.....	15,000.00	8,622.99	3,291.01	36.09	102.50	511.85	67.06	284.31	39.40
40	South Carolina.....	15,000.00	7,799.97	3,336.01	137.12	79.88	105.62	231.69	532.98	378.33
41	South Dakota.....	15,000.00	7,118.34	3,637.28	3.16	655.50	133.82	663.74	874.94	27.00
42	Tennessee.....	15,000.00	10,568.31	911.71	14.70	89.53	109.22	1,021.24	148.21	11.75
43	Texas.....	15,000.00	8,912.88	1,263.00	80.15	128.68	117.14	1,161.53	119.75	284.00
44	Utah.....	15,000.00	8,583.35	3,032.29	55.80	25.81	289.50	786.84	182.47	-----
45	Vermont.....	15,000.00	8,083.65	2,853.44	44.82	26.54	17.95	261.26	59.42	-----
46	Virginia.....	15,000.00	9,824.82	1,230.44	43.37	147.30	61.10	506.86	181.60	93.00
47	Washington.....	15,000.00	9,314.80	2,073.10	42.29	222.82	15.10	302.65	163.10	-----
48	West Virginia.....	15,000.00	10,942.87	1,264.50	16.45	-----	-----	339.97	5.00	-----
49	Wisconsin.....	15,000.00	8,500.00	2,358.00	7.45	-----	540.22	975.21	103.63	6.78
50	Wyoming.....	15,000.00	11,610.00	184.80	12.25	161.05	162.72	503.62	-----	-----
	Total.....	720,000.00	482,953.55	78,594.80	2,950.56	5,884.22	5,802.81	23,506.90	13,664.90	3,378.79

¹ Including balance from previous year.

the agricultural experiment stations for the year ended June 30, 1912.

Classified expenditures.									
Feeding stuffs.	Library.	Tools, imple- ments, and machin- ery.	Furniture and fixtures.	Scientific appa- ratus.	Live stock.	Traveling expenses.	Conti- nent- al expenses.	Build- ings and repairs.	Bal- ances.
\$28.17	\$58.91	\$120.69	\$307.27	\$351.74	\$120.65	\$75.09		\$296.45	1
5.40	228.49	280.48	196.52		115.50		78.87		2
8.78	116.46	391.79	296.16	474.60	214.83		150.97		3
	34.28	1,023.85	124.45	685.27	101.05	1,078.96	\$8.00	518.55	4
	115.75	154.63	172.65	607.08			453.40	738.60	5
182.08		9.96		107.68		101.55			6
121.80	13.05	31.85		189.13	231.85	23.92		65.65	7
	115.82	17.37		394.30	1,392.25	54.54		395.07	8
	92.08	140.61	5.40	322.52		799.76		184.21	9
1,019.37	185.38	141.95	82.30	451.89		7.00	149.35	750.00	10
	58.69	244.43	43.90	1,251.10			405.30	111.47	11
419.15			74.87	12.97	175.00				12.76
172.20	203.05	110.52		640.01	766.82	871.38	3.00		13
1,346.70		188.60	20.00	347.37			111.05		14
957.48	32.16	878.59	119.35	146.61	868.50	422.89		418.12	15
				349.77	18.00	63.67	70.00	8.00	16
135.47	110.85	197.99	67.54	545.75	89.70	329.14		27.49	17
18.70	42.80	51.13	24.44	314.62	10.90	222.13		288.87	18
1,118.60	408.51	294.95	106.25	217.97	300.00	18.55		701.22	19
	2.00	8.40	417.70	308.68		24.95		140.58	20
	23.17			1,566.73	1.00			152.44	21
60.01		112.83	155.91	367.84	55.50	299.83		100.92	22
1,311.91		824.92	112.59		3,337.50	29.45		217.01	23
1,914.61			36.75	165.95	1,410.65	108.17		426.12	24
113.40	83.10	577.08	57.30	341.34	60.00	570.78		192.40	25
397.27	22.04	294.18	23.80	749.30		219.36			26
210.00	69.76	200.10	68.50	435.39	110.00	402.77	14.75	14.55	27
752.94	17.83	70.41	33.92	427.01	62.32	343.12		186.21	28
240.00	322.06	432.62	130.50	560.47	237.50			170.67	29
348.56		451.12	232.50	106.90	225.00			400.00	30
	66.34	83.76	41.87			51.96		642.62	31
									32
452.38	134.40	145.97	345.62	53.30	76.55	73.95		304.23	33
523.15	2.54	50.98	87.70	394.43	647.60	68.99		367.05	34
84.00	17.45	2.50	474.20	427.90		21.05		102.48	35
1,047.00	13.50	199.50	29.80	319.30	120.75	151.88		310.25	36
597.40	16.21	48.70	39.90	1,043.93	2.00	481.40		379.53	37
	81.62	238.64		767.50		530.07		154.35	38
852.71	50.54	367.31	8.95	294.55	243.25	32.30		195.27	39
1,036.76	83.90	52.50		547.03	200.00	187.10		291.11	40
669.83	60.45	195.85	92.26	574.69	70.50	77.31		145.33	41
	236.32	58.75	185.40	1,130.73		155.42		358.71	42
241.30	261.33	213.09	140.14	850.15	173.75	19.30		749.16	43
690.10	34.82	642.70	44.96	182.36		315.75		133.25	44
2,213.16	92.51	14.00	30.50	735.71		135.70		431.34	45
368.35	22.57		194.44	284.45	1,500.00	389.68		149.83	2.19
113.82		296.29	130.45	1,336.64	35.00	776.49		177.45	47
882.19	15.30			1,533.72					48
1,654.04		47.50	5.00	890.60	15.00				49
578.03	87.07	40.30	30.60	756.85	227.35	237.10		304.63	50
22,886.82	3,404.62	9,897.40	4,876.32	24,760.35	13,107.67	11,151.33	95.75	12,503.74	579.23

PROGRESS IN AGRICULTURAL EDUCATION, 1912.

By C. H. LANE, *Assistant in Agricultural Education.*

SUMMARY FOR THE YEAR.

One of the most remarkable world-wide trends during 1912 was toward agricultural education, not only of the farmers but of the masses, city people as well as country. Agricultural education has been given to the masses through farmers' institutes, through better farm trains, by the introduction of agricultural courses in the public schools, by the agricultural high schools as separate institutions, by the agricultural colleges, by experiment station bulletins, and the agricultural press, by the popular monthly and weekly magazines, through the daily newspapers, and even from the pulpits of our churches, as well as by the organized bureaus of the State and National Governments.

The United States Department of Agriculture has found it impossible to supply the publications needed by the colleges and schools that are teaching agriculture or to meet satisfactorily the other demands they have made upon it for lectures, advice, and other assistance. The Bureau of Plant Industry enrolled in the boys' corn clubs approximately 68,000 boys and in the girls' canning clubs 20,000 girls. The Office of Experiment Stations, which officially represents the department in its relations with agricultural colleges and schools, has had the cooperation of the other bureaus in this work, but has found it impossible to keep pace with the demands made upon it.

Problems in agricultural education, with special reference to the training of teachers, received increased attention at numerous national educational conventions, including the Association of American Agricultural Colleges and Experiment Stations, the National Education Association, and the American Association for the Advancement of Agricultural Teaching.

The agricultural colleges have added many new and costly buildings, increased their teaching force, organized departments of agricultural education, enrolled more students in agriculture than ever before, enlarged their extension departments, held summer schools and larger courses for teachers of agriculture, and increased materially the literature for the use of teachers and pupils in public schools. Several colleges on private foundations have added courses in agriculture and others are preparing to do so as soon as they can get teachers. The same is true of the State normal schools.

The number of technical agricultural schools of secondary grade, aside from those maintained in connection with agricultural colleges, increased from 60 in 1910 to 88 at the present time. Eighty of these are maintained wholly or in part by State funds in some 17 States, and entail an annual expenditure by the State in which they are located of \$780,000 for instruction and maintenance, not counting large expenditures for land, buildings, and equipment.

The number of public and private high schools and academies receiving students in agriculture is now 1,886, of which 285 inaugurated courses in agriculture under the stimulus afforded by State aid, while 1,601 started the work without such aid. In 1910 there were only 432 of the unaided high-school departments of agriculture, a little more than one-fourth of the present number.

EDUCATIONAL WORK OF THE DEPARTMENT OF AGRICULTURE.

The educational work of the department has been extended in several directions. As heretofore, the Office of Experiment Stations has represented the department in its relations with educational institutions, but the other bureaus and divisions have also done more than in former years to extend the general development of facilities for instruction in agriculture.

The Weather Bureau maintains a school of instruction to prepare young men for the position of assistant observer in this country. Concerning this school the Chief of the Weather Bureau reports as follows:

The duties of assistant observer at the 200 stations of the weather service outside of Washington are largely technical in character, and require on the part of the employee a knowledge of instruments and of methods of tabulating the results therefrom that can be obtained only by actual experience. It may be safely said that a new employee does not become really useful until he has had at least three months' experience under the guidance of a trained observer. If he is given immediate station assignment, the quality of the instruction that he will receive will depend largely on the kind of work performed at his station. Certain classes of work, such as the making of weather maps and the taking of observations, are common to all parts of the country, but as a rule the general character of work is largely determined by the size and geographic position of the city in which the station is located. Thus under local training alone the instruction given a new employee is neither uniform nor complete unless he has made the round of all sorts of stations. It has therefore been decided to give new employees a systematic course of instruction in all branches of the work performed at any station, wherever it may be located. This is to be done at Mount Weather. Two rooms in the physical laboratory building have been set apart for the purpose, and all the paraphernalia of a fully equipped Weather Bureau station have been procured and properly installed. The aim will be to give the employee under instruction the actual practical experience necessary to fit him for the duties required of him later in his term of service. The observation station will be conducted in precisely the same manner and under the same general instructions as a regular station of the bureau. Meteorological observations will be made and prepared for transmission by telegraph. Copies of telegraphic

reports received from the central office in Washington by mail will be translated and the results spread upon weather maps, and the new employees will be instructed in the several methods of map making and the preparation of the plates from which weather maps are printed. A course in the construction and upkeep of meteorological instruments will also be afforded, so that each new employee may be able not only to interpret the indications of meteorological instruments, but also to discover and remedy faults that may arise in them.

The Bureau of Plant Industry has continued and extended its club work with boys and girls in connection with the farmers' cooperative demonstration work in the South. The members enrolled in this work have increased from a small beginning five years ago until now the enrollment approximates 68,000 boys and 20,000 girls. In his 1912 report the chief of the bureau reports on this work as follows:

Corn clubs.—Although the weather conditions were unfavorable for corn, the records made by the boys in 1911 were none the less remarkable and excellent. The diplomas of the Secretary of Agriculture to winners of prize trips to Washington were still more generally sought after. In some of the States two or more boys did so well that additional trips and diplomas were awarded. Twenty boys were winners of a trip to Washington. Seven of these boys each produced over 200 bushels of corn on his acre at a very low cost, and all of the yields were remarkable under the conditions that prevailed in the respective States. It is noteworthy also that hundreds of other boys in the corn clubs throughout the South did nearly as well as these winners.

The great educational value and economic importance of this work is unquestioned. The continued liberality of business men and citizens generally in giving prizes and otherwise cooperating in the work indicates an increasing and vital interest in it. The enrollment for 1912 is 12,104 greater than for the previous season.

Cotton clubs.—As planned, boys' cotton clubs were organized in the various States for the season 1912, the heaviest enrollment being in Texas and Oklahoma. It is intended that members of these clubs shall be boys who have had one or more years' training in corn clubs. They are expected to cultivate at least 2 acres of land and to give special attention to seed selection for the purpose of increasing the quality of the staple as well as striving to secure large yields at low cost. The total enrollment of these clubs for the season was 4,690, and indications are that results will be very gratifying.

Girls' canning clubs.—That there was a demand and evident need for the work with girls, corresponding to the boys' corn-club work, is shown by the rapid increase in enrollment and the intense interest shown in this division of the work. The expenses of the girls' club work are paid entirely from the funds of the general education board, but the work itself relates directly to the problem of readjusting southern farm conditions by the raising of home supplies. This work reaches directly into the home, and it is noticeable that at the meetings held for instruction in canning the mothers are usually present and evince as much interest in the proceedings as do the club members themselves. The season's enrollment of girls was 23,550. Each cultivates one-tenth of an acre in tomatoes and other vegetables and is taught how to can and otherwise utilize the product. Many girls did excellent work and secured large returns from their one-tenth acres in 1911, and reports indicate that they will be even more successful during the coming year.

In addition to the regular club work, as above outlined, the demonstration work has aided in the formation and conduct of pig clubs, poultry clubs, and other work of similar character. Usually the boys' and girls' work is carried on in cooperation with the agricultural colleges of their respective States.

The Forest Service continued to cooperate with the Office of Experiment Stations in promoting the teaching of forestry in the public elementary and secondary schools. Under this cooperative arrangement two publications, entitled "Forestry in Nature Study" and "A Working Erosion Model for Schools," have been issued. Eight special sets of lantern slides, with accompanying lecture outlines, were prepared for the use of teachers on the following subjects: General forestry, conservation of the forests, the work of the Forest Service, nature study and forestry, botany and forestry, manual training and forestry, geography and forestry, and agriculture and forestry.

In addition to courses in forestry given at summer schools and lectures delivered at important educational meetings, the service gave direct assistance to four agricultural high schools in the vicinity of Washington that are conducting experiments in introducing brief courses in wood-lot forestry into their regular school work. The results of these experiments are being incorporated into a proposed Farmers' Bulletin, Farm Forestry for the High School.

Cooperation in establishing demonstration wood lots at five agricultural high schools in Tennessee has been started and will be carried further during the year.

Besides the lectures given by the Office of Public Roads in connection with road-improvement trains, several papers were also read at colleges and universities and before scientific organizations and societies. Short lecture courses on highway engineering were presented at the University of Idaho and at the University of Kentucky. The plan of appointing graduates in civil engineering from the leading institutions in the country to the position of engineer student in the office has been continued. Concerning this feature of the work the Director of the Office of Public Roads says in his report for 1912:

The office has continued during the year to appoint graduates in civil engineering from the leading engineering institutions of the country to the position of civil engineer student. In order to obtain eligibles, the United States Civil Service Commission, on March 13 and 14, 1912, held an examination in various parts of the country. From the register thus established 10 appointments were made and during the year there were 4 resignations. Other resignations from the staff of the office were 2 highway engineers, 1 bridge engineer, and 1 chemist.

During the first year that engineer students are connected with the office they are given a thorough training in all branches of highway work, both in the field and in the laboratories, while at the same time their services are fully utilized by the office. At the end of the first year, if the students prove worthy and it is found that the needs of the service justify it, they are promoted to the position of junior highway engineer. At the close of the second year they are eligible for further promotion to the grade of highway engineer, and ultimately to the position of senior highway engineer.

This project has given excellent results, and the engineers after a few years' training in the office are in demand for State and county work. The practice of permitting engineers to resign is detrimental to the service, as the office is constantly

losing some of its best men, but the benefits derived by the various States and counties through the distribution of trained men to all sections of the country are sufficient to vindicate the wisdom of such a policy.

The Chief of the Division of Publications of the department in his annual report says that while more than 34,000,000 publications were distributed during the year, a much greater number would have been required to supply the demand. He further states that many of our publications are being used as textbooks; and it is believed that such use should be encouraged, even at the expense of an increase in the fund for printing.

EDUCATIONAL WORK OF THE OFFICE OF EXPERIMENT STATIONS.

The act creating the office of specialist in agricultural education in the Office of Experiment Stations prescribes quite definitely the duties to be undertaken as well as the amount of money that shall be available for carrying on the work. Under this act it is made the duty of the specialist in agricultural education to "investigate and report upon the organization and progress of agricultural schools in the several States and Territories, and upon similar organizations in foreign countries, with special suggestions of plans and methods for making such organizations more effective for the dissemination of the results of the work of the Department of Agriculture and the experiment stations, and of improved methods of agricultural practice."

In carrying out these provisions the agricultural education service has maintained advisory relations with all phases of the movement for education in agriculture.

RELATION TO AMERICAN INSTITUTIONS.

Upon invitation it has conferred with State school authorities and others regarding courses in agriculture, the establishment of new schools, and the equipment and management of existing schools. This work has continued to be in charge of Mr. D. J. Crosby, specialist in agricultural education, who has been assisted by Messrs. C. H. Lane and B. B. Hare, assistants in agricultural education; Miss M. T. Spethmann, in charge of foreign literature on agricultural education and the card catalogues of American and foreign agricultural schools; and Miss M. A. Agnew, in charge of the card directory of teachers and investigators in agriculture, the organization lists of the agricultural colleges and experiment stations, and the official mailing lists.

The editorial work of the department of agricultural education in the Experiment Station Record involved the reviewing of 2,300 foreign publications and about 1,500 American publications. The regular publications relating to the statistics and organization of the agricultural colleges and experiment stations, lists of educational publica-

tions and institutions, and the annual review of progress in agricultural education were issued. In addition to these a bulletin describing the county schools of agriculture and home economics in Wisconsin, a circular containing a report on college courses in rural economics and farm management, a Farmers' Bulletin on forestry in nature study (in cooperation with the Forest Service), and a Yearbook article on "Community work in the rural high school" were prepared and published. Other publications relating to agricultural schools in Arkansas, types of children's garden work, and a working erosion model for schools prepared in the Forest Service, were submitted for publication.

Considerable time was given to the study of American agricultural schools and methods of instruction in agriculture. On invitation from State school officers the specialist in agricultural education and one of his assistants studied schools and methods of elementary and secondary instruction in agriculture in California and Oregon, attended and addressed several conferences of educators in those States, and helped to map out plans for the future development of agricultural education in their schools. Also, on invitation, an assistant in agricultural education visited and studied all of the agricultural schools in Georgia and is preparing a report on them. In cooperation with the Forest Service short courses in wood-lot management were conducted experimentally at the Agricultural High School of Baltimore County and at the Manassas Agricultural High School, with a view to working out carefully some of the problems of conducting such courses and then publishing the results for the benefit of other similar schools. In cooperation with the Bureau of Plant Industry the office detailed Miss Susan B. Sipe, science teacher in Normal School No. 1 of the District of Columbia, to make a study of types of children's garden work in several large cities and in State educational institutions from Pittsburgh to the Pacific coast, and her report has been submitted for publication.

The card index of foreign schools and literature now contains over 9,000 cards, that of American schools and literature over 11,000 cards, and that of American teachers and investigators in agriculture about 2,600 names. In addition to these there is a card directory of about 2,500 American teachers in secondary and elementary schools, mainly teachers of agriculture. These card lists are valuable sources of information, not only for members of the office staff, but also for institutions in quest of teachers of agriculture.

Cooperation with the Association of American Agricultural Colleges and Experiment Stations has been continued. The director of this office has continued to act as bibliographer of the association, as chairman of its committees on instruction in agriculture and on the history of agricultural education, and as dean of the Graduate School of Agriculture, the fifth session of which began July 1 at the Michigan Agri-

cultural College. The agricultural education service of the office helped prepare the report of the association on rural economics and farm management and has begun collecting data for a report on the work of the agricultural colleges in training teachers of agriculture.

Members of the agricultural education staff have attended numerous conferences on agricultural education and have spoken at several large gatherings of teachers. This work and that of visiting and studying agricultural schools has taken our men into 28 States, over 38,500 miles of railway travel, at a total cost to the office of \$1,328. Local agencies paid one-fourth of the cost of the field work of the service and would have been willing to pay for additional assistance of the kind if members of the staff could have given more time to this work. This, however, could not be done with so few people to attend to the rapidly growing correspondence, the preparation of publications, and other regular work of the office.

RELATION TO FOREIGN INSTITUTIONS.

AFRICA.

Considerable attention has been given to the matter of disseminating practical instruction regarding improved methods of farming in several of the countries of Africa. In Algiers, for example, the work has been conducted by the schools of agriculture, departmental and special professors of agriculture, the School of Sciences of Algiers, the botanical and agricultural stations, agricultural societies, horticultural and agricultural committees, primary schools, and the annual congress of agriculture held in each of the three principal towns of the departments of the colony.

The only schools in Egypt giving instruction in agriculture are the school of agriculture at Ghizeh and three industrial schools with agricultural sections at Damanhour, Tough, and Luxor, but local contributions to the amount of \$289,165 have been made for the erection and equipment of industrial and agricultural schools. All of these schools are under the control of the minister of public instruction, who received for the department of agricultural and technical education an appropriation for the current year of about \$450,000, of which \$41,521 was for schools.

A new college of agriculture, known as the Grootfontein College of Agriculture, was opened at Middleburg, in the Cape of Good Hope, on a site until recently occupied by a military remount station. This location is especially adapted to the purpose of agricultural instruction and demonstration because it is typical of a vast area and is suitable for practical and scientific instruction in the breeding and management of ostriches, cattle, horses, sheep, goats, and pigs, and in dry-land farming, irrigation, and dairying. At first applicants were admitted from the seventh grade, but after January 1, 1913, only students who

hold the matriculation examination certificate of the Cape University, or its equivalent, will be admitted. Numerous scholarships are available, including one of \$729 a year, tenable for two or three years, to be awarded annually for advanced and specialized study abroad.

ARGENTINA.

The reorganization of the system of agricultural education authorized December 27, 1907, includes higher instruction, special instruction of a technical-practical character adapted to local conditions, practical instruction for future agriculturists and horticulturists, and extension work. The higher instruction is now being offered by the Agricultural and Veterinary Institute at Buenos Aires and the agricultural and veterinary faculty of the National University at La Plata; the special instruction by the School of Agriculture and Husbandry at Cordoba, the School of Viticulture at Mendoza, and the School of Arboriculture and Sugar Technology at Tucuman, with their experiment stations; the practical instruction by the Practical School of Horticulture and Arboriculture at Casilda, the Practical School of Dairying at Bellville, the Practical School of Forestry at Benitez, the Practical School of Subtropical Agriculture at Posadas, and the Practical School of Fruit Culture at San Juan, all offering 3-year courses. The extension work includes practical courses for young people and adults, itinerant courses, correspondence, cooperative experiments, local gatherings and expositions, encouragement to agricultural associations and syndicates, and the organization of district agronomes.

The consul general of Buenos Aires reports that a school of aviculture has been opened at La Plata as an annex to the zoological garden, to give instruction in poultry and bee keeping and in the rearing of rabbits and pigeons, the latter for consumption and as carriers. A course in carpentry and other trades necessary in the work of an aviculturist is also offered.

AUSTRALIA.

The government of South Australia has decided to establish a 2-year course in forestry to consist of university training, together with practical instruction in the forests for from 9 to 12 months. The course will include physics, botany, physiography, biology and entomology, surveying, chemistry, and forestry. A forestry diploma will be awarded to students who pass the examinations in the forest subjects, and they will then become eligible to appointment in the woods and forests department.

A department for special instruction in the wool and sheep industry has been added to the curriculum of the Sydney Technical College, New South Wales. The course embraces both sheep growing and sheep shearing and the grading and marketing of the fleece.

AUSTRIA.

Statistics show that in 1910-11 there were 219 agricultural and forestry institutions in Austria, an increase of 5 over the preceding year. They include, among others, 3 agricultural academies, 8 agricultural and 5 forestry high schools, 2 high schools for viticulture, fruit culture, or horticulture, 42 farm schools, 88 agricultural winter schools, 11 elementary forestry schools, 24 dairy and housekeeping schools, 28 elementary special schools for horticulture, fruit culture, viticulture, vegetable, flax, hop, and meadow culture, alpine farming, or apiculture.

The first attempt to give instruction in agriculture to the soldiers in the Austrian Army was a course offered from November 16, 1910, to May 19, 1911, at Marburg. Forty hours were devoted to lectures at the barracks, and 8 hours to practical demonstrations on the school farm.

The first farm and home management school in Austria was opened at Otterbach in the fall of 1911, with a 2-year theoretical and practical course of instruction. In connection with this school is a rural housekeeping school with a 1-year course of instruction.

The consul general at Budapest reports that agricultural subjects are taught in all Hungarian schools. There are 7 agricultural colleges with experiment stations, for the maintenance of which the budget for 1911 provided \$192,000. There are also 32 agricultural schools of lower grade, for which the cost of maintenance in 1911 was estimated at \$865,000. Of this Parliament has appropriated \$702,000, the balance coming from tuition fees, etc.

BELGIUM.

Following is an outline of horticultural instruction in Belgium:

(1) Horticultural lectures given by local horticultural societies subsidized by the State. These lectures are given on Sundays, and are attended by horticultural apprentices, gardeners, and amateurs. In the winter of 1911-12, 2,755 lectures were given in series of 15 lessons and less.

(2) Elementary professional horticultural sections annexed to elementary schools in which the instruction is particularly adapted to the regions, extends through 1 or 2 years, and consists of at least 60 theoretical lessons of 1 hour each on the elements of horticulture, and 30 practicums of 2 hours or less. A certificate is awarded to students passing the final examination. The aid given by the department of agriculture varies from \$87 to \$164. There are also temporary schools of horticulture in which the staff of instructors is sent from one place to another, continuing in a locality as long as the attendance is good.

From a numerical standpoint the woman on the farm is a very important factor in Belgium social economy, there being 385,000 and

325,000 women employed, respectively, in commerce and industry, while no less than 514,000 are engaged in agricultural work, principally dairying and poultry raising.

The organization known as Cercles de Fermieres was founded in 1906 with 2 "cercles" and 115 members. The "cercles" in 1910 numbered 74 and had a membership of 6,929. The work of the organization is primarily agricultural extension instruction by means of lectures, libraries, shows, competitions, and the like, but also embraces the social and moral advancement of the rural population. Among the lectures and demonstrations given for the last few years, the following subjects are noted: The fermiere, her mission as housemother, housewife, and farm assistant; practical poultry keeping; butter making; kitchen gardening; stable hygiene, and the rational feeding of cows; advantages of cooperative dairying; care of young farm animals; farm bookkeeping; the organization of agricultural banks; and the proper investment of money, etc. The lectures in 1906 numbered 4 and the attendance 90, and in 1910, 232 and 14,290, respectively.

The "cercles" may be organized in such a way as to secure benefits and subsidies from the ministry of agriculture.

BOLIVIA.

The June, 1911, number of the Bulletin of the Pan American Union announced the inauguration in April of a government agricultural school in the Potopoto Valley at Sopocachi, near La Paz. Augustin Luna Pizarro, a practical agricultural engineer of wide experience and a noted botanist, is director of the institution.

BOSNIA.

The system of agricultural and forestry instruction in Bosnia and Herzegovina includes agricultural instruction in the Training School for Teachers at Sarajevo; elementary public schools, in which systematic agricultural instruction is given; four farm and fruit culture schools located, respectively, at Ilidez near Sarajevo in Bosnia, Modric in northern Bosnia, Livno on the Dalmatian border, and Gacko in Herzegovina, which offer 3-year and 1-year courses of instruction and have experiment stations connected with them; itinerant agricultural instruction and special courses; and the forestry school at Sarajevo with a 3½-month's course for forest overseers and a 2-year course.

BRITISH ISLANDS.

In a previous report attention was directed to the comprehensive efforts for agricultural development which have been initiated in Great Britain under the provisions of the development and road

improvement funds act of 1909, and to their great prospective significance for all workers in agricultural science. (*Progress in Agricultural Education, 1911*, p. 284.) The period which has since elapsed has been productive of additional progress in the formulation of policies, the allotment of funds, and the actual commencement of a number of specific lines of work, and the enterprise in its present status reveals several aspects of general interest.

A report recently issued, covering the first nine months of the operation of the act, affords an indication of the policies of the commissioners and the directions along which development is at present proposed.

The commissioners announce that as regards agriculture they propose to devote their attention principally to three lines of action. They aim first at increasing the amount and quality of production by aiding in the extension of a system of scientific investigation and research and a system of education to bring the results into practice; secondly, at increasing the variety of production, by determining what new crops and industries can be added with reasonable probability of profit; and, thirdly, at encouraging the organization of cooperative enterprises. They also propose to stimulate forestry development, but consider the first step in this work to be the formation of a body of trained foresters.

It is of interest to note that one principle upon which the commissioners are insisting to applicants is that in all cases there be submitted a definite plan of operations. This is somewhat analogous to the project method which is becoming increasingly adopted in this country. The commissioners state that "a reasonable elasticity in the details of schemes is of course quite legitimate, particularly when the schemes are in the nature of breaking new ground; and the commissioners do not expect the destination of a grant or loan to be fixed down to the last penny before anything is spent. But they are not prepared * * * to recommend the expenditure of public money till the lines of a scheme and estimates of its cost have been prepared and approved in some detail." The formulation of a comprehensive policy covering the whole field of agricultural research and the needs of the entire Kingdom was an early subject of consideration by the commissioners, who have now declared definitely for the adoption of such a policy as compared with one of "piecemeal grants."

An application for an advance of \$250,000 per annum was submitted to the commissioners by the board of agriculture and fisheries for the organization of a system of scientific research and experiments in the science, methods, and practice of agriculture and the promotion of technical advice to farmers. In response to this the expenditure

of \$165,000 per annum for research alone has already been authorized and a tentative plan for the initiation of the work has been agreed upon.

The scheme approved by the commissioners provides for research in 11 groups of subjects, covering more or less completely the whole field of agriculture. Work in each group will be concentrated at one, or, in some cases, two, agricultural research institutions. Special investigations for which provision can not be made at one of these institutions will be carried on by means of separate grants. The funds available are expected to provide aid at present for two research institutions for plant breeding, two for animal pathology, two for agricultural zoology, one research institution and two or three local experimental gardens for fruit growing, and one institution each for plant physiology, plant nutrition and soil problems, animal nutrition, dairying, and the economics of agriculture. An institution for animal breeding is ultimately contemplated, but operations at present will be confined to one or two small grants.

The research institutions are to be selected from the universities, colleges, or similar existing agencies, preference being given to those already possessing special facilities for a given line of work. The grants are to be annual in duration, but it is intended to secure continuity in work and to employ permanent staffs. The institutions are expected to contribute from their own funds for the maintenance of the work and for the provision of buildings, laboratories, or equipment, though grants covering 50 per cent of the cost may be contributed from the fund under certain conditions. Cooperation with other institutions is to be encouraged, and duplication of work reduced to a minimum.

The publication of results is apparently to be largely through the scientific journals, rather than directly by the institutions in the form of bulletins or reports. Popular abstracts are in all cases to be furnished to the Journal of the Board of Agriculture for the information of farmers and the general public.

Great importance is attached to the provision of a local staff available for advisory work and for conducting local tests of the results of the research work under field conditions and the dissemination among the farmers of the improved methods which may be discovered. It is hoped that the local advisory staff stationed at centers distributed through the country will form a link between the research institutions on the one hand and the practical farmer on the other.

A sum not exceeding \$15,000 per annum is also to be available for special investigations not otherwise provided for. These are to be conducted under the auspices of existing institutions and utilizing their facilities so far as possible.

The process of organization of the research work has already revealed as one of the principal difficulties the scarcity of trained investigators. "Nothing has impressed the commissioners more than the clearness with which the fact has appeared that the first condition of any considerable progress in these ways is the creation of a trained staff. It is useless to expect that immediate results of real value can be obtained on a large scale merely by expenditure. * * * The number of men really qualified to conduct agricultural research in this country is at present exceedingly small, and it obviously can not be increased at a moment's notice."

With a view to remedying this condition so far as possible, a portion of the fund is being utilized for scholarships in agricultural science. Twelve scholarships of \$750 each per annum have been established, mostly at Cambridge University, these being tenable for three years.

The encouragement of agricultural instruction and extension has also been favored in other grants from the fund. One of these set aside a sum not to exceed \$1,625,000 for use to March 31, 1916, in agricultural education under the auspices of county education authorities. This grant has been temporarily withdrawn, pending a readjustment of certain administrative details, but it is expected that it will eventually be utilized for providing county staffs of agricultural instructors, working from headquarters termed "farm institutes." These institutes will provide demonstrations, short courses both at the headquarters and in traveling schools, and otherwise be at the disposal of the farmers of the region.

A grant of \$60,000 per annum is also available for more technical advice and the investigation of local agricultural problems. This fund is to be administered by the board of agriculture and fisheries, through not to exceed 12 approved universities and colleges in England and Wales. The men thus employed will be officers of the colleges and represent them officially in the dissemination of results.

From this survey it will be apparent that an important experiment as to the ways and means of governmental aid to agriculture is being undertaken, and that the plan which is undergoing trial presents many novel features.

The Royal Agricultural College at Cirencester has incorporated its collegiate instruction with that of the University of Bristol. Three-year degree courses in agriculture and forestry have been provided, the first year to be spent in Bristol and devoted to general science and similar subjects, and the second and third years at Cirencester. Mr. H. J. Elwes has placed a portion of his afforested land at Colesborne at the disposal of the college for research purposes.

As to the occupations of agricultural students in England and Wales after graduation, out of a total of 1,769 students, 1,631 have returned to occupations connected with the land.

CANADA.

Work on the buildings of the Saskatchewan Agricultural College has been in progress for over a year. These include a central building, a stock-judging building, an agricultural engineering building, a power plant, a dormitory, a horse and cattle barn, and a sheep barn.

The judging pavilion, which cost \$42,000, is a fireproof brick and cement structure, having a judging ring 90 feet long by 25 feet wide, and seating about 500 people. There is also a slaughter room, with a seating capacity of 125, with a cooling room on one side and immediately adjoining it a large refrigerating room. A room for smoking meats is also provided.

The agricultural engineering building is 125 feet long by 75 feet wide and cost about \$60,000. A complete course in farm engineering for the agricultural student is being outlined. Agricultural extension work is under way, and experimental work is being organized as a part of the college work.

It is announced that the 1912 session of the Manitoba Legislature has separated the College of Agriculture of Manitoba from the University of Manitoba and given it power to confer its own degrees.

By a recent amendment to the regulations for agricultural education in high schools and continuation schools by the Ontario Department of Education, the duties of the teachers of agriculture under the ministers of agriculture and of education, respectively, are now clearly defined.

Local control is in the hands of an advisory agricultural committee composed of four members of the school board and four other persons who are actively engaged in agricultural pursuits. The agricultural teacher is hereafter to conduct classes not only in the high-school center to which he has been appointed but at other centers selected by the minister of education on the application of their high-school or continuation-school boards. The minimum length of a school class in agriculture is to be four weeks. Shorter classes for farmers are provided under the authority of the minister of agriculture.

The minister of education has appointed Prof. S. B. McCready, of the Ontario Agricultural College, inspector of these classes and director of elementary agricultural education.

GERMANY.

Agricultural instruction for soldiers is now given in nearly every garrison in the Empire. Instruction is usually offered in the winter half-year on Saturday afternoons and extends through from $1\frac{1}{4}$ to $1\frac{1}{2}$ hours. It is given in the majority of cases in the barracks, but in some cases in agricultural winter schools. The number of lectures varies from 6 to 32, and in many Provinces the lectures are followed

by discussions. In East Prussia a pamphlet containing an outline of the subject is placed in the hands of the soldiers. Demonstration material from agricultural schools, the question box, lantern slides, etc., have been successfully used. In some of the garrisons the theoretical instruction is supplemented by excursions to well-managed farms and experiment fields, the planting of trees and demonstrations in orchards, plowing, mowing, and milking contests, fertilizer tests, etc. The instruction is conducted by directors of agricultural winter schools, agricultural teachers, officials of the chambers of agriculture, and other agricultural organizations, and occasionally by veterinarians, practical farmers, and Army officers.

ITALY.

By royal decree of December 21, 1911, the higher council of agricultural, industrial, and commercial instruction was abolished and a council for agricultural instruction substituted. The new council consists of 14 members appointed by the minister of agriculture and gives advice regarding proposed legislation and general provisions for agricultural instruction, agricultural schools of any grade, aid to students, and other questions relating to agricultural, forestry, and zootechnical studies which he may refer to it.

A recent report of the British foreign office states that all the schools of agriculture in the Provinces of Venetia have adopted the plan of equipping demonstration farms. Among them is one at Gambarare of about 47 acres, small tracts of which are leased to farmers for use according to directions from the school.

MEXICO.

A recent number of the Boletin de la Sociedad Agricola Mexicana announces the establishment of a new school of agriculture at San Francisco de Borja, in Lower California, by the Brothers of Christian Schools. The instruction will be theoretical and practical and will extend through four years.

A practical poultry school has been established at Tacubaya near the City of Mexico. Three courses of three months each are offered, beginning November 1, February 1, and May 1, respectively. The instruction is both theoretical and practical and for men and women.

SPAIN.

Under the name of the Rural Spanish Society an organization has been formed at Bilbao, Spain, for the promotion of agriculture through the fostering of agricultural education, the introduction of modern farm machinery, improved plants and seeds, commercial fertilizers, insecticides, and fungicides, and the use of improved methods of combating animal diseases.

A large tract of land with extensive buildings has been acquired near Guernica, which will be utilized for the establishment of an institute of agricultural instruction. The instruction will be for the present of an elementary nature, but will be both theoretical and practical in scope. Experimental work is also contemplated. Funds will be provided in part by the development on a commercial scale of the agricultural estate which forms a part of the property.

WEST INDIES.

The advanced 3-year course at the agricultural school at San Cristobal, which was officially inaugurated April 1, 1911, trains young men for the public service as itinerant instructors in the Provinces under the direction of agricultural inspectors, as agricultural teachers in the schools, directors of large estates, etc.

EDUCATIONAL WORK OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The twenty-fifth annual convention of the association was held at Columbus, Ohio, November 15-17, 1911. The attendance was a large and representative one, and the meetings were of great interest.

The presidential address, by W. H. Jordan, dealt mainly with certain ideals of education, the need of leadership in agriculture, and the agricultural colleges in relation to these.

Dr. Jordan held it to be fanciful to expect that any large proportion of actual farmers will ever be college trained, and he pointed to the fact that in the past the influence of the agricultural college has been largely exerted through men who have become investigators, teachers, publicists, and managers of large agricultural enterprises, rather than through the distribution of practical farmers.

In the vocational courses training in the fundamental sciences was pointed out as a requirement in making effective workers. The lack of this was thought to be a too prevalent weakness. "If the colleges expect to give their graduates a good start on the road to success as teachers and station workers they should seriously consider a curriculum that deals more largely with the fundamental sciences and less with agricultural technics as a superstructure." And, furthermore, "the man is best prepared for the life of a farmer who knows the most about the fundamental sciences and their relation to his vocation, and for this reason I can but regard the time as inefficiently spent that is devoted in college to observations and exercises of an ultrapractical character or to gaining information that is easily acquired from the ordinary experiences of practical life."

He pleaded for the atmosphere of scholarship in our vocational institutions: "We should carefully guard and cherish the intellectual impulses and equipment of the teacher and the investigator,

because they are the instruments whose edge must be fine if we are to be successful in rightly fashioning the minds and hearts of young men and young women and in laying open the hidden recesses of truth."

P. P. Claxton, United States Commissioner of Education, in an evening address before the convention, dealt with the training of teachers for agricultural instruction. Referring to the very great increase in the number of students attending the colleges of agriculture and mechanic arts and the development of interest in work of this character in the secondary and normal schools, he pointed out the great demand for teachers, present and prospective, and stated that "if the public schools shall do what they ought to do" there would be a demand for 20,000 teachers of agriculture and manual training and domestic science. The present demand has far outstripped the colleges.

The report of the committee on instruction in agriculture presented by A. C. True, chairman, dealt with (1) the grouping of studies in college courses in agriculture, and (2) the relation of rural economics to farm management.

Referring to a previous report of the committee on the arrangement of agricultural courses, it was stated that further study of the question indicates that some of the more elementary subjects in agriculture should be taught in the freshman year.

On behalf of the committee, Thomas F. Hunt presented a report on rural economics and farm management, indicating that there is a general consensus of opinion, although not entirely unanimous, that there are two classes of subject matter in the field of economics—one dealing with the farm as a unit (farm management) and the other with the community as a unit (rural economics). The desirability of developing strong courses in both rural economics and sociology was emphasized.

The report of the committee on graduate study, presented by H. P. Armsby, chairman, dealt mainly with the courses to be given at the fifth session of the Graduate School of Agriculture at the Michigan Agricultural College in the summer of 1912. The report also referred to a recent bulletin of the Bureau of Education on "The facilities for graduate study in agriculture in the United States."

The subject of the preparation of men for teaching and for experiment-station work was presented in papers by Alfred Vivian, of Ohio State University, and H. J. Wheeler, of the Rhode Island station.

Prof. Vivian held the best training for teachers or investigators in agricultural lines to consist in, "first, a good collegiate course in agriculture along the lines recommended by the committee of this association, this course to include a good foundation in general science,

a fair introduction to the humanities, including a reading knowledge of German, a general survey of the whole field of agriculture, and a limited specialization in one department. Upon this must be built graduate study with the major in the line in which the student expects to devote himself. In connection with his major he should be introduced to the principles of good research and should do a part of his minor work in education."

It was suggested that a system of scholarships and fellowships to encourage graduate study on the part of exceptional men would give great returns in the production of efficient teachers and investigators.

The new committee on college organization and policy made its first report, through W. E. Stone. It dealt mainly with the attitude which the land-grant colleges should take toward the movement to popularize agricultural knowledge and improve agricultural practice. The committee took the view that these colleges should assume the leadership in these activities and that the ultimate organization of these agencies should center in these institutions.

It was recommended that in practice a division of these various activities should be made into coordinate departments—(1) the college or department of agriculture, charged with college instruction; (2) the experiment station, charged with experimentation and research; and (3) the department of agricultural extension, charged with the extramural work of instruction, demonstration, and popular teaching of every form, and including such supervision of secondary teaching as may be called for.

The proposal to organize secondary teaching in the extension department developed considerable discussion and opposition, the present practice being more largely in favor of holding this in the college of agriculture.

With reference to the relation of the station to extension the committee on experiment-station organization and policy reiterated its position—

that nothing in the organization of extension work or its distribution should be permitted, on the one hand, to detract from the prestige of the station in the results of the work already accomplished, or, on the other hand, so hamper its staff with details as to interfere with their carrying out the work of investigation. * * *

The extension department of the college should carry the common stock of agricultural knowledge to the farming public, leaving it to the station to directly or indirectly disseminate the special results of its investigations and demonstrate their application.

The committee on extension work, through President K. L. Butterfield, chairman, presented a quite voluminous report dealing with the theory of extension work, its forms and definitions, present status, relationships to other agencies and departments, administrative

organization and financial support, the training of workers, and some of the special problems of extension work.

The committee concludes that:

Extension work promises to be one of the very largest fields of endeavor in our whole agricultural question. It will attempt one of the largest tasks that the Government has ever endeavored to perform, namely, to reach effectively through instruction and inspiration at least 50,000,000 of rural people.

The men who do this work must be men of vision, who have some comprehension of the fundamental character of the task, with enough imagination to conceive its importance and possibilities. They must have some of the missionary spirit. They must be men who see ahead of them a permanent life work. They must realize the significance of the rural problem and they must be ambitious to help solve the problem.

John Hamilton, of this office, read a paper in the section on extension work, on "The correspondence course; its organization and methods," which was followed by a considerable discussion relating to the experience and success of such work at several institutions. There was much evidence that this form of instruction has an important place in the general scheme of extension work and is being well received. In Pennsylvania the college now has over 3,500 persons taking these courses. Special correspondence courses for teachers were advocated.

Much interest developed in the consideration of various measures for the promotion and development of agricultural education, experimentation, and extension, as defining the general policy of the association.

E. Davenport advocated the endowment by the Federal Government of secondary education in the public high schools and State normal schools, the State college of agriculture for the special purpose of training teachers for these institutions, and a limited amount of extension teaching by the colleges "as a temporary measure until secondary education in agriculture can be fully established." When agricultural high schools are in operation such extension teaching as will be needed can be done from these schools instead of from the colleges.

Provision for traveling specialists or "efficiency men" was indorsed, to advise with farmers direct, to demonstrate approved methods, establish demonstration fields, orchards, or other farm units, etc., these to be directly under the charge of the experiment stations.

Branch stations were considered undesirable, because such stations are unnecessary for purely geographical reasons, and they would either duplicate the principal station or become merely a demonstration farm. "In either case they would weaken research, not strengthen it. Large funds are needed for important research, and all experience shows that the funds should be concentrated as much as possible."

T. F. Hunt made a strong plea for vocational training, urging that if the Nation is to hold its intellectual and industrial place among the nations of the world such a training must be provided for boys and girls between the ages of 14 and citizenship. The value of a national measure would lie not so much in the money which it would appropriate as in the general educational policy which it would inaugurate.

"The first requisite to the development of local agricultural or industrial conditions is to have an educated man in each community, charged with the responsibility of devoting at least a portion of his time to the problems to be solved." This would be supplied by a system of agricultural high schools. The speaker favored a measure which would provide in a broad way for the needs of the country in the direction of secondary agricultural education, the training of agricultural teachers, and the maintenance of branch experiment stations.

Assistant Secretary W. M. Hays maintained that "the great waste in country life is through ignorance," and that the big problem in eliminating this is the bringing of the body of knowledge now available into form and taking it to the people, young and old, who need it. He plead for an educational system to include not only the traditional subjects, but the vocational as well. He emphasized the importance of this in developing farm managers and leaders and in building up a more efficient body of farmers and a broader farm life. An essential feature of this movement is the development of agricultural teachers through the normal schools.

In its final action the association again declared itself in favor of Federal appropriation in aid of extension work, in harmony with the autonomy of the several States as recognized in previous legislation. It also declared in favor of Federal aid for public schools of secondary grade providing education in agriculture, home economics, and manual training; but it failed to express itself in favor of appropriation for agriculture in normal schools, and it tabled a proposal to favor the establishment of branch experiment stations on the plan provided in a bill now before Congress.

A. C. True in his report as bibliographer, dealt with the library and its use for college and station purposes. From a survey of the present condition of station libraries the conclusion was reached that "attention to the development of the library is not generally keeping pace with that given to improvement in buildings and laboratories or other station equipment."

Some systematic instruction in the use of books and libraries in connection with the college courses in agriculture was advised.

The committee on the semicentennial celebration reported, through Dr. A. C. True, that the plan to hold an international congress of agri-

cultural education in 1912 to celebrate the anniversaries of the passage of the first Morrill Act and the act establishing the National Department of Agriculture, and the twenty-fifth anniversary of the passage of the Hatch Act, had to be abandoned on account of the failure of Congress to take action in the matter.

The committee recommended that the executive committee be instructed to make a special feature, at the next meeting of the association, of exercises commemorating the passage of these important acts.

The program of the college section was devoted entirely to a discussion of the physical and social factors in education, including gymnasium work, intercollegiate athletics, social activities, and public speaking.

W. J. Kerr, of Oregon, discussed means of encouraging a larger proportion of students to engage in gymnasium work and other forms of athletics. He recognized the importance of physical training as a vital part of the scheme of education, but characterized athletics alone as inadequate. As a means of encouraging physical training, he recommended giving it recognition as an educational phase of college work and encouraging intercollegiate contests and all forms of outdoor sports on large and well-equipped playgrounds, cooperation of the other members of the faculty with the professor of physical education in organizing botanical trips, cross-country runs, and other like outdoor exercise, and required gymnasium work for all.

H. J. Waters, of Kansas, read a paper on "Ideals for intercollegiate athletics and means of obtaining them," in which he asserted the belief that the colleges should employ no professional coaches and no coach who does not have other college duties; that they should not use athletics for advertising purposes; that the department of athletics should become a department of proper student conduct in which, among other things, athletics should take the place of foolish student pranks; that all college athletics should be on college grounds and with college students; that high scholarship should be required of those engaging in athletics; that recruiting should be abolished and freshmen not be allowed to engage in intercollegiate contests.

K. L. Butterfield, of Massachusetts, discussed means of promoting healthful activities in the social body. He expressed the belief that social activities along wholesome lines should be recognized as a legitimate part of college life, and recommended the bringing of students and faculty together on committees for the purpose of regulating and directing social activities.

He stated that at Massachusetts Agricultural College there is a standing faculty committee on student life, and this committee has eight subcommittees on such phases of student life as student organizations, social union, musical organizations, fraternities, publications, and other organizations.

H. L. Russell, of Wisconsin, described the system of student advisers in vogue at the University of Wisconsin, in which each student is assigned to some professor or assistant professor as his adviser, and this professor communicates to the parents of the student the fact that he has been placed in such an advisory position.

Means of promoting greater interest among students in public speaking was discussed in a paper by D. H. Hill, of North Carolina, who deprecated all tendencies in modern platform work toward eloquentary effects, and stressed the importance of studied efforts on the part of the speaker to adapt himself to his hearers and to appeal rather to their judgment than to their emotions.

WORK OF THE NATIONAL EDUCATION ASSOCIATION.

CHICAGO MEETING.

The summer meeting of the National Education Association, held at Chicago, July 6-12, 1912, like several preceding conventions of the association, gave considerable attention to rural and agricultural education. The interest of the association in the subject of agricultural education has increased rapidly in recent years. According to an historical paper by B. M. Davis, agricultural education was not considered as a separate subject by the National Education Association, except in connection with the agricultural colleges, until 1893, when the association held its meeting in connection with the International Congress of Education, and a paper on agricultural education was read by a Russian delegate. Now, it is an unusual thing for a convention of the association to be held without some attention to agricultural education in the general meetings and the almost exclusive attention of one or more departments given to that subject.

The Chicago meeting was no exception to other recent conventions. The Friday morning general session of the association was devoted entirely to the general topic, "Rural life conditions and rural education," which included such special subjects as "A social and educational survey of the rural community"; "What is being done to meet the problem by the schools of Guilford County, N. C., and by the State of Oregon"; and "What the National Government can do." There was also a lecture by E. J. Russell, director of the Rothamsted Experiment Station, Harpenden, England, on "The school, the college, and the English farmer." The subject of sanitation in the rural community and the teaching of hygiene in the schools was considered at the general session of Thursday evening.

The department of rural and agricultural education devoted one session to the presentation of papers on the redirection of rural education and one to the consideration of a report of its committee on course of study in agriculture. At the former session there were

discussions relating to the work of the United States Bureau of Education, the committee of the National Education Association on rural education, the Ohio plan of improving rural schools through agriculture, the improvement of these schools through boys' and girls' clubs, and the work of the national committee on agriculture.

Another session of this department was held with the School Garden Association of America and was devoted to papers and discussions on rural and city school gardens in the United States and Canada, home gardens and experiment plats, and forestry in rural schools.

In its declarations and resolutions the association heartily indorsed "the comprehensive plan now before Congress for increasing the facilities in State colleges of agriculture and mechanic arts, State normal schools and elementary schools for training in agriculture, domestic economy and other industrial work for the great mass of our people, through the public schools of the entire country," and urged upon all interested in agricultural education "the necessity for definite progress along the line of vocational guidance for youth," and such an enrichment of the courses of study in our elementary schools "as to make it possible to discover the tastes, tendencies, and abilities of the child previous to the time when such vocational decisions are to be made."

The association authorized its president to appoint a committee of 11 members, made up of educators, employers, employees, and social workers, to make a special study of this whole question of vocational choice and vocational instruction with a view to making recommendations concerning a general policy as to vocational training in the public schools.

ST. LOUIS MEETING.

The winter meeting of the National Education Association at St. Louis, February 26-29, 1912, included the regular winter meeting of the department of superintendence, special meetings of the national council of education and the department of normal schools, and regular sessions of six affiliated organizations, among which was the national committee on agricultural education. The enrollment was the largest ever recorded at a winter meeting—about 1,900—and the program was full of interest to those concerned with vocational education.

The department of superintendence devoted one round-table session to agriculture in the rural school, at which several interesting papers were read, including "The educative value of the study of agriculture," by Earl Barnes, of Philadelphia; "To what extent can agriculture be taught below the high school," by Hon. P. P. Claxton, United States Commissioner of Education; and the "Next step in teaching agriculture in the rural schools," by E. C. Bishop, of Iowa State College.

The national committee on agricultural education held several sessions dealing with courses of study in agriculture. A joint session with the department of normal schools afforded opportunity for a discussion of the place of the normal school in agricultural education. The National Society for the Study of Education held one session for the discussion of its annual yearbook, which as usual was published in two parts, the first devoted to industrial education and the second to agricultural education in secondary schools.

This latter publication was prepared under the direction of D. J. Crosby, of this office, and was by him discussed at the convention. It included the following papers: "The training of teachers for secondary courses in agriculture," by A. C. Monahan; "The vocational agricultural school," by R. W. Stimson; "State-aided departments of agriculture in public high schools," by D. J. Crosby; "High-school agriculture without State subsidy," by W. H. French; "Short courses and extension work in agriculture for high schools"—in the South, by H. F. Button, in the North, by F. R. Crane; "In public high schools should agriculture be taught as agriculture or as applied science?" by W. R. Hart; and "In the public high schools agriculture should be taught as agriculture, not as applied science," by G. F. Warren.

AGRICULTURAL EDUCATION AT THE SOUTHERN COMMERCIAL CONGRESS.

The annual meeting of the Southern Commercial Congress was held at Nashville, Tenn., in May, and was devoted to the presentation of facts showing the educational and agricultural recovery of the South during the past half century and the discussion of measures for the further advancement of this great region along these lines. A considerable number of officers of this department and of the agricultural colleges and experiment stations in the Southern States took part in this Congress. Conferences were held on soils, forage and horticultural plants, forestry, animal husbandry, drainage, roads, cooperative marketing, etc. Special interest was manifested in two conferences on extension teaching in agriculture, at which the attendance was relatively large and the discussion relatively broad.

The wide scope of extension work in agriculture already inaugurated in the South was illustrated and enforced at the opening of the first conference by President Soule, of the Georgia College of Agriculture. He displayed an attractive series of charts showing how different agricultural problems and interests of Georgia were being taken up by the extension force of the college, partly in cooperation with this department. The lines of work included farmers' institutes, movable schools, field demonstrations, special railroad trains, eradica-

tion of the cattle tick, boys' and girls' clubs, cooperation with the district agricultural high schools, etc.

The sympathy and support which extension work in agriculture is now receiving from educational leaders in the South were shown by the attendance and addresses of Chancellor Barrow, of the University of Georgia; President Thach, of the Alabama Polytechnic Institute; and President Hardy, of the Mississippi Agricultural College. In order to come to this meeting, Director Dodson, of the Louisiana Experiment stations, and Prof. Bryant, of the Kentucky College of Agriculture, had left special railroad trains which were carrying agricultural information to multitudes of farmers in their respective States. Their interesting accounts of the success of these trains and the special means taken to make them effective in spreading new knowledge among the rural people were received with much enthusiasm.

In these conferences, as well as in the general sessions of the congress, much attention was given to the great work of the farmers' cooperative demonstration system, inaugurated by the late Dr. Seaman A. Knapp and continued under the supervision of his son, Mr. Bradford Knapp. The latter presented at one of the conferences a carefully prepared paper in which the educational purpose of the work was clearly set forth, as well as the system of State and local agents and the methods of organizing and conducting the work among the farmers. The plans for carrying on this work in cooperation with State agencies were described by Mr. Knapp somewhat as follows:

There are now cooperative arrangements in force in every Southern State except two. Some of these are not as complete as desired, and not all have taken the form regarded as the very best, but every effort is being made to meet conditions as they are found.

In the State of Alabama the State legislature a year ago appropriated the sum of \$25,000 annually, and created a State board of agriculture, consisting of the commissioner of agriculture as ex officio chairman, the director of the State experiment station, and the head of the school of agriculture in the Polytechnic Institute; and the farmers' cooperative demonstration work in Alabama is conducted in cooperation with this board.

In Arkansas a different form of cooperation is in existence. There the State legislature permits each county to appropriate money to assist the Federal Department in carrying on the demonstration work, and practically every county in the State has appropriated at least half the salary of the agents, the total sum thus subscribed being \$40,000. This works very satisfactorily, and the relations with the agricultural college of the State are of such close and friendly character as to prove mutually advantageous.

But neither of these conditions approaches, in the final analyses, the system recently introduced in South Carolina, which is regarded as an important and significant step in advance. There the agricultural college and the Federal Department are directly cooperating in conducting the demonstration work in the State. A State agent has been appointed jointly by the two cooperating agencies, and district and local agents are appointed by a mutual understanding. One agent is located in each county, and the State is divided into three districts for the purpose of supervision under district agents. Each of these agents is not only the agent of the farmers' cooperative demonstration work, but is also the agent of Clemson College. Furthermore the State agent is a member of the faculty of Clemson College, and as such is the head of the extension work of the college and superintendent of the farmers' institutes of the State.

Thus under one head are coordinated the cooperative demonstration work of the Department of Agriculture and the demonstration and extension work of the college and the farmers' institute forces of the State. The organization is so logical and so full of possibilities that its ultimate success is thought to be assured. Under this system the local agent will not only conduct demonstration work but he will also have back of him the extension force of experts and the entire agricultural faculty at the institution, as well as that of the department at Washington. The advantages of the system in promoting a wider influence and in spreading information as to the short courses and other activities of the college are believed to be manifold.

In a paper on the "Organization and administration of extension teaching in agriculture," the director of this office summarized the present status of extension work in agriculture as conducted by the agricultural colleges and experiment stations, and emphasized the urgent need of the more systematic and thorough organization of this work under the supervision of the colleges.

Considered as an essential feature of the American system of agricultural education, it was held to be primarily the business of the State to create and maintain the institutions through which extension teaching in agriculture shall be conducted. Since it is an educational enterprise it will naturally be carried on by educational institutions rather than by administrative departments. The National and State Departments of Agriculture may very properly aid in this work, but the chief burden of responsibility for it in the several States will naturally fall on the agricultural colleges.

AGRICULTURAL EDUCATION AT OTHER CONVENTIONS.

The second annual meeting of the American Association for the Advancement of Agricultural Teaching was held at Columbus, Ohio, November 14, 1911, and was attended by teachers, extension workers,

and others interested more particularly in the promotion of secondary instruction in agriculture.

A paper on "The proper equipment for teaching agriculture in secondary schools" was presented by D. O. Barto, of Illinois, who discussed in considerable detail the need of collections, illustrative material, apparatus, and other equipment which must be available, either as part of the regular equipment of the school or as the property of near-by farms, if the teaching of agriculture is to be made effective.

A. C. Monahan, of the United States Bureau of Education, in a paper on "What is being done to prepare teachers of secondary agriculture," stated that there are now over 100 secondary special schools of agriculture located in 17 different States and nearly 2,000 public and private high schools giving instruction in agriculture. About 200 of these special or public high schools are giving four-year courses in agriculture and nearly all of these are demanding agricultural-college graduates as teachers. This demand is placing a heavy burden upon the agricultural colleges, which they are now endeavoring to carry by organizing departments of agricultural education and outlining courses for teachers. Of the 50 colleges for white students 36 now offer some opportunity for teacher-training in agriculture, and 9 of these have four-year prescribed courses for such teachers. The courses offered in California, Illinois, Maine, Massachusetts, Tennessee, Missouri, Mississippi, Michigan, and Kansas were described in some detail.

The need of training teachers and the kind of training they should receive for secondary school work in agriculture were the topics discussed in a paper by A. V. Storm, of Iowa. Prof. Storm emphasized the necessity of the agricultural colleges taking up this work. He believed that the teachers of agriculture in secondary schools should have nothing less than a good, well-rounded, four-year agricultural course, including all of the general courses in agriculture and professional courses in psychology, history of education, principles of education, special methods for high-school subjects, school management, and practice teaching.

In an informal way, the association discussed the need of adequate means of keeping its members and teachers of agriculture generally throughout the country informed concerning new textbooks and other literature on agricultural education and on the features of progress in agricultural education. A need was again expressed for an agricultural education journal which should be to the teachers of agriculture what the Experiment Station Record is to investigators. The association instructed its executive committee to endeavor to bring about the establishment of such a publication.

The Fifteenth Conference for Education in the South was held in Nashville, Tenn., April 3-5, its purpose being the improvement of economic and civic conditions in the South through education.

In the Nashville meeting more than ever before was emphasized the improvement of rural conditions. Rural school work was extensively discussed by experts from several States, farm demonstration workers and the country church had a place on the program, and invitations were sent out to 1,000 farmers and 600 country ministers.

Round-table conferences were held during the two days preceding the regular conference, at which the subjects considered were rural school improvement, sanitation, rural high schools, and the work of the corn, tomato, and poultry clubs.

An afternoon conference was devoted to agriculture and agricultural education. John L. Coulter discussed "Farmers' cooperation"; Bradford Knapp, director of farm demonstration work of this department, "The demonstration work and some of its results"; and O. B. Martin, assistant in charge of demonstration club work of this department, "The objects of the boys' and girls' demonstration work."

Among other topics discussed either at conferences or at meetings of affiliated societies were "The rural school as a center of country life," "The rural life survey for church and school," "The education of the negro in the South," "Health in country schools," and "Rural education a national failure."

The twenty-second annual convention of the Southern Educational Association was held in Houston, Tex., November 30 to December 2, 1911. Such subjects as agricultural education, home economics instruction, and the consolidation of rural schools were considered both in general sessions of the association and in section meetings.

At one of the morning sessions "The education of the farmer's child" was discussed by M. L. Brittain, of Georgia; "The training of boys and girls for more efficient rural life in the South," by E. S. Richardson, of Louisiana; and "Community work for agricultural schools," by D. J. Crosby, of this office. In all of these discussions the need was emphasized of improving the rural school plant by consolidation and otherwise, of revising the courses of study to make them apply to rural conditions, and of utilizing agricultural clubs, demonstrations, lectures, and other popular means for the home training of both young and old. The consolidation of schools was also considered at one session of the department of school boards.

The department of industrial education devoted one session to agricultural education, with papers by E. E. Kone, M. L. Brittain, L. N. Duncan, N. M. McGinnis, D. J. Crosby, and S. C. Wilson. In the department of normal schools the preparation of teachers of agriculture for the children of the public schools was discussed, and in the southern educational council a large share of one session was devoted to a discussion of better means for adapting education to the needs of rural schools.

The First International Dairy Show was held at Milwaukee, October 10-18, 1911, with an excellent attendance throughout. The opening address was by Secretary Wilson of this department.

Among the features of the show were the 500 entries of dairy stock, the extensive machinery exhibits, a model creamery operated by the Dairy Division of this department, a cheese factory fitted up with modern machinery, the interstate butter contest, a demonstration herd showing groups of cattle fed in different ways, a child-welfare exhibit, and illustrative material from the Milwaukee Health Department and the University of Wisconsin. Among other awards were those to herdsmen for ability in fitting and showing cattle, neatness of person, and herd quarters.

The Sixth National Dairy Show took place in the International Live Stock Exposition amphitheater in Chicago, October 26 to November 4, 1911. Over 1,000 of the leading dairy breeds were shown. The exhibits of dairy machinery and appliances excelled those of previous years, and Federal, State, and city governments were strongly represented as to their work in connection with the dairy industry. Unusual prominence was accorded the enterprise by the daily press of Chicago, and the attendance was gratifying as compared with previous years.

A noteworthy feature of the show was the attendance of the President of the United States, who gave a brief address, in which he commended the scope and purpose of the enterprise and emphasized the necessity of adopting improved farming methods and breeding more efficient dairy stock as a means of keeping pace with the requirements of the increasing population. The President also offered a silver cup to the student making the highest score in the dairy stock judging contest, and presented this cup in person to the winner, Russell Jensen, of the South Dakota college.

The students' judging contest attracted much attention, teams from 10 institutions competing. As in previous years, valuable trophies and individual scholarships were offered by the various breeders' associations and others. The Kentucky University team won first place, with Ohio State University second, and South Dakota third. The Maryland college won first place in judging Ayrshires and Jerseys, and Kentucky on Guernseys and Holsteins.

Throughout the discussion there was general agreement that rural locations are advantageous for such institutions and that instruction in agriculture, with accompanying outdoor work, is almost imperative. One great difficulty that many of the institutions encounter is that of keeping the boys long enough to give sufficient instruction in agriculture to be of permanent value.

Considerable progress is reported in extending the scope of the International Association of Poultry Instructors and Investigators

to include poultry instructors and investigators throughout the world. A provisional international committee has been formed, with representatives in England, Scotland, Ireland, Australia, Tasmania, South Africa, India, Germany, Holland, Belgium, Denmark, Norway, and Italy.

Arrangements are being made for an initial meeting of this committee in London, July 18–24, 1912. Edward Brown, secretary of the National Poultry Organization of England, has been elected president, and Dr. Raymond Pearl, honorary secretary pro tem.

THE GRADUATE SCHOOL OF AGRICULTURE.

The prospectus of the Graduate School of Agriculture, issued just before the close of the year, announced that the fifth session of the school would be held at the Michigan Agricultural College, East Lansing, Mich., July 1–26, under the auspices of the Association of American Agricultural Colleges and Experiment Stations. Some idea of the character and extent of this enterprise may be had from the following excerpts from the prospectus:

PURPOSE OF THE SCHOOL.

The purpose of the Graduate School of Agriculture is to give advanced instruction in the science of agriculture, with special reference to the methods of investigating agricultural problems and teaching agricultural subjects.

EQUIPMENT OF COLLEGE DEPARTMENTS.

AGRICULTURAL DEPARTMENTS.

The agricultural division of the college includes the following departments: Animal husbandry, dairy husbandry, horticulture, forestry, agricultural education, soils, crops, poultry, farm mechanics, and farm and horses.

The agricultural building is a five-story fireproof structure with a frontage of 190 feet, and the wings are 110 feet from front to rear, while the stock-judging pavilion projects 70 feet to the rear of the wings. In addition to furnishing offices and laboratories for nearly all departments of the agricultural division, the building has classroom seating for 1,850 persons.

The dairy building, a two-story brick structure, contains lecture rooms, laboratories storage, and curing rooms, which are well equipped.

The horticultural building, also a two-story structure, is well provided with facilities for instruction, in addition to a greenhouse and four forcing houses.

The farm buildings, including those used for horticultural and experimental purposes and poultry, are valued at \$32,475. They are arranged systematically in groups and have been remodeled and refitted as object lessons within reach of the farmers' means.

SCIENCE DEPARTMENTS.

The scientific departments (bacteriological, botanical, chemical, entomological) of the Michigan Agricultural College are housed each in its own building; accordingly, the building facilities are excellent for the conduct of the instructional and investigational work.

The facilities of the bacteriological department are quite complete for suitable and satisfactory microbiological studies in agriculture, home economics, and veterinary medicine.

The botanical department is abundantly equipped to meet the demands of systematic botany, plant pathology, and plant physiology.

The chemical department is well provided with an abundance of apparatus to instruct a large number of students in general, analytical, organic, and applied chemistry.

The entomological department is especially furnished with such apparatus as is necessary for teaching and research in systematic, physiological, and histological work.

LANDS AND LIVE STOCK.

The college lands comprise 684 acres, subdivided as follows: Farm, 332 acres; forests and forest nursery, 164 acres; orchards, nurseries, and garden, 45 acres; experiment station plats, 40 acres; campus, 90 acres; and athletic field, 13 acres. These lands are valued at \$68,400. The farm has over 13 miles of tile drain and is subdivided by 13½ miles of fencing.

The live stock equipment consists approximately of 30 horses, 60 beef cattle, 55 dairy cattle, 175 sheep, 150 swine, and 2,000 chickens. Twenty-five breeds and types of live stock are represented, viz: Horses, 3; beef cattle, 5; dairy cattle, 4; sheep, 7; and swine 6, not including 12 breeds of poultry. These have a total valuation of about \$25,000.

OTHER EQUIPMENT.

In addition to the building equipment already referred to, the horticultural department has the following special features: Seven acres of student vegetable gardens, 10 acres of orchard, 6 acres of small fruits, a vineyard of 50 varieties of grapes, and a cold-storage plant equipped with a gravity brine-cooling system.

The 29-acre nursery of the forestry department contains over 4,000,000 conifers and 152,440 broad-leaved forest seedlings. The remaining 135 acres comprise well-timbered forest woodlands.

The soils classrooms and laboratories occupy the greater portion of the second floor of the agricultural building, and will accommodate 96 persons at one time. The crops department occupies the floor above in much the same way.

The farm mechanics department occupies a large portion of the lower floor with farm machinery, power machinery, and cement laboratory equipment. The forge and bench work are given in a separate two-story building 45 by 90 feet.

REQUIREMENTS FOR ADMISSION.

Only persons who have completed a college course and taken a bachelor's degree will be admitted to the privileges of the school, except that admission may be granted to nongraduates who are recommended by the faculties of the colleges with which they are associated as persons properly qualified to profit by advanced instruction in agriculture.

COURSES OF STUDY.

Instruction will be given in seven main lines—soils and plant physiology, animal physiology, agronomy, horticulture, animal husbandry, and poultry, rural engineering, rural economics and farm management.

CONFERENCES.

The Saturday morning periods and Wednesday and Friday evenings will be devoted to conferences on general matters relating to collegiate and secondary instruction in agriculture, extension work, and the general principles of research.

Leaders in agricultural education and research have been secured to open these discussions, which will then be thrown open to members of the graduate school.

FACULTY.

The faculty will include 7 officers of the United States Department of Agriculture, 15 members of the faculty of the Michigan Agricultural College, and 18 professors and experts from 14 other agricultural colleges and experiment stations. In addition, lecture courses and seminars will be given by Dr. T. N. Carver, professor of economics, of Harvard University; Dr. H. C. Sherman, professor of food chemistry, Columbia University; Dr. L. B. Mendel, professor of physiological chemistry, Yale University; Dr. Oscar Riddle, research associate of the Carnegie Institution of Washington; and H. N. Ogden, professor of sanitary engineering, Cornell University.

Many interesting and valuable matters will also be brought out from an international viewpoint in lectures given by Dr. E. J. Russell, director of the Rothamsted Experiment Station, England; Dr. F. H. A. Marshall, professor of agricultural physiology, Cambridge University, England; and Dr. Oscar Loew, of the Hygienic Institute, Munich, Germany.

THE AGRICULTURAL COLLEGES.

Agricultural colleges were in operation during the year in all the States and Territories except Alaska. Counting the 16 separate institutions for negroes in the South, there were 67 such institutions. The attendance at these institutions and the funds available for their support were greater than in any previous year. They had 61,663 students in interior courses, 159,657 in exterior courses, including correspondence and extension courses (not farmers' institutes), and 33,281 in all other courses, making a total, counting none twice, of 251,349 students. This was a decrease of less than 3 per cent as compared with 1911, but an increase of 86 per cent over 1910. The decrease in the total number of students as compared with 1911 is due almost wholly to a falling off in the number of students registered in correspondence courses.

The agricultural students in these institutions increased from 19,170 in 1911 to 21,594 in 1912, a 12 per cent gain. The additions to the equipment of these colleges were valued at over \$8,000,000 and to their income over \$3,500,000.

APPROPRIATIONS.

The State appropriations for the maintenance of agricultural colleges, the construction of buildings, and the purchase of equipment have made normal progress.

In Colorado the general assembly has made appropriations to the college aggregating \$200,000, of which \$90,000 is to be used for improvement and maintenance.

A total appropriation of \$165,000 was made to the University of Florida for the ensuing biennium, of which \$30,000 was for a new building for the college of agriculture.

The last Legislature of Georgia appropriated for the ensuing biennium \$250,000 for the furtherance of education in agriculture and extension teaching at the agricultural college.

The Iowa Legislature renewed for another period of five years the mill tax for the erection of buildings. It is estimated that over \$1,000,000 will be available for this purpose during the next six years. A library, to cost \$225,000, and a stock-judging pavilion, to cost \$20,000, were among the buildings definitely authorized. Special appropriations were also made for equipment of the domestic technology building, gymnasium, and veterinary hospital.

The Massachusetts Legislature of 1912 passed a law granting \$250,000 a year to the agricultural college for administration, maintenance, instruction, experiment station, and extension service. Eighty thousand dollars was appropriated for special purposes, the chief item of which was for an addition to the dining hall.

The appropriations made at the last session of the New Jersey Legislature include \$100,000 for an agricultural building and \$12,000 for a dairy building.

The New York Legislature has made appropriations to the college of agriculture aggregating \$907,000, of which \$788,000 is made immediately available. Of this amount, \$329,000 is for the erection of new buildings for the use of the departments of forestry, agronomy, and animal husbandry, \$182,000 for the completion of work already under way, and the remainder for current maintenance and similar expenses.

State appropriations aggregating nearly \$200,000 have been made in North Dakota for the ensuing biennium. Of this, about \$112,000 is for the maintenance of the college and \$13,600 for that of the school of forestry.

The General Assembly of Rhode Island has made an appropriation of \$75,000 for a new science building, to accommodate the college departments of chemistry, botany, zoology, physics, and geology, and the station work in biology.

The last session of the Wisconsin Legislature authorized a three-eighths of a mill tax for general university purposes. This tax will yield \$1,089,000, of which the college of agriculture will receive for the ensuing year approximately \$200,000. In addition to this, specific State appropriations have been made of \$75,000 for a home-economics building, \$90,000 for an agricultural chemistry building, and \$235,000 for 187 acres of land, purchased by the university adjoining the university farm on the west and to be used, so far as needed, for agricultural work.

BUILDINGS.

An agricultural hall at the University of California has been completed. (Pl. XI, fig. 1.) It is a white granite structure of fireproof construction and cost about \$200,000. The faculty, students, and alumni of the university are planning to erect in the museum corridor of the new building a bronze bust in honor of Dr. E. W. Hilgard, emeritus professor of agriculture.

The Hawaii Agricultural College is now housed in three temporary buildings located in the residential district of the city of Honolulu. For the permanent home of the college about 90 acres of land have been secured in Manoa Valley. A plan for the development of the college has been prepared showing the relative positions of the various buildings. The first of these buildings, of reenforced concrete, has been completed at a cost of \$75,000. (Pl. XI, fig. 2.)

The University of Idaho has completed a live stock judging pavilion for the use of classes in animal husbandry. This is a one-story structure, 36 by 60 feet, in mission style, with stucco finish on the outside, with raised seats, wide roomy space for live stock specimens, and equipped with a heating plant, an office, and stall room for stock. There has also been completed a modern dairy and live-stock barn for the use of the college and station. The main part of this barn has two floors and is 48 by 66 feet in size, with a concrete silo 33 by 16 feet. There is also a wing for dairy stock 36 by 55 feet, provided with a milk room, an office, and complete equipment.

The erection of a three-story stone and brick library building to cost \$100,000 was begun in April at Purdue University.

The new domestic technology building at Ames, Iowa, was formally dedicated May 1. The attendance in this department has shown a decided increase. The new veterinary plant, costing \$150,000, has been completed. A new \$150,000 gymnasium is in the process of erection.

The laboratory for dairy instruction at the Massachusetts College of Agriculture will be ready for occupancy in September, 1912. This is a three-story fireproof structure, of dark red brick with granite foundations, with 60 feet frontage and 120 feet in depth, and with its equipment will cost about \$85,000. The main floor will contain milk receiving rooms, washing and sterilizing apparatus, bottling and shipping rooms, refrigerators, an ice-cream plant, and the separator, cream ripening, and churning rooms. On the second floor will be a dairy bacteriological laboratory, a milk testing laboratory, a laboratory for advanced students, and a dairy museum. A cheese room and a cheese ripening room, a laundry, an ice-making plant, and a dairy machinery laboratory will be located in the basement. A unique feature of the building will be the observation corridors on each floor, by means of which visitors may watch operations going on in the different rooms without actually entering them.

A new building (Pl. XII, fig. 1), 168 by 169 feet, is under construction at the University of Minnesota, for the department of agricultural engineering, and it is hoped to complete at least the portion devoted to shopwork early in 1913. A girls' dormitory, costing \$50,000, has recently been completed at Morris, and a similar dormitory for boys

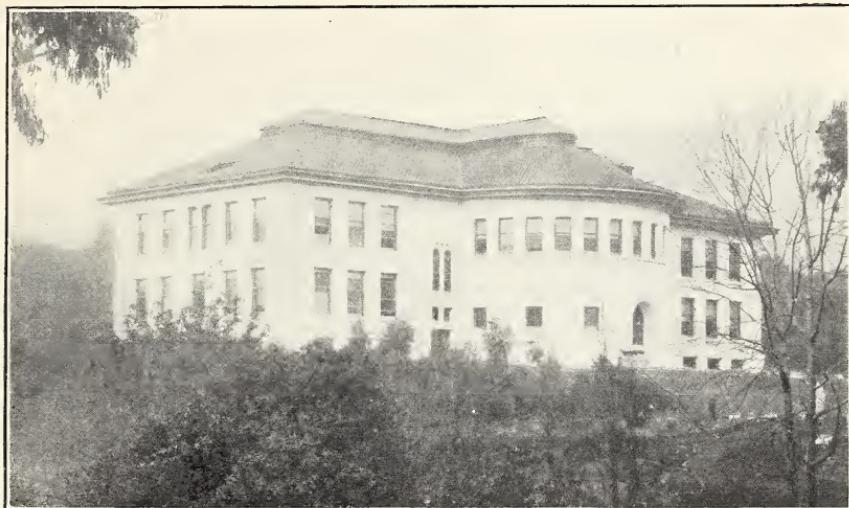


FIG. 1.—AGRICULTURAL HALL, UNIVERSITY OF CALIFORNIA.



FIG. 2.—MAIN BUILDING, COLLEGE OF HAWAII.



FIG. 1.—NEW MECHANICAL BUILDING, MINNESOTA COLLEGE OF AGRICULTURE.



FIG. 2.—NEW LADIES' DORMITORY, MINNESOTA COLLEGE OF AGRICULTURE.

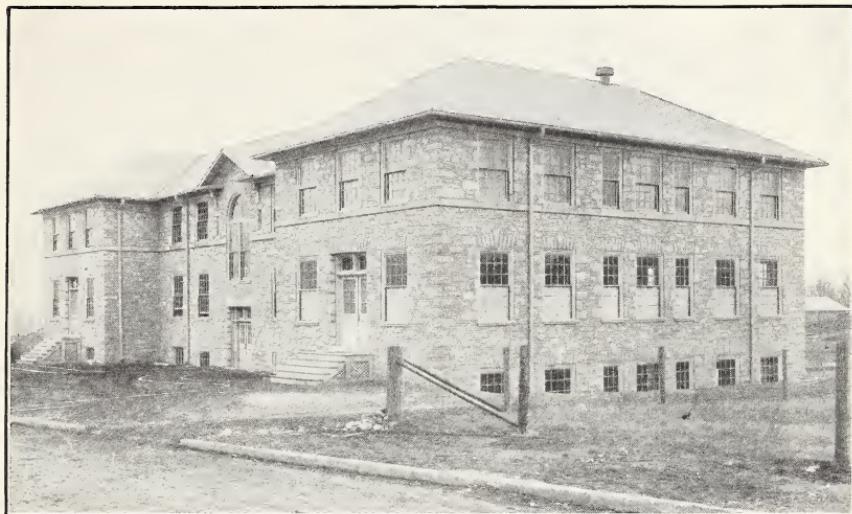


FIG. 1.—VETERINARY BUILDING, UNIVERSITY OF MISSOURI.



FIG. 2.—AGRICULTURAL BUILDING, UNIVERSITY OF MISSOURI.

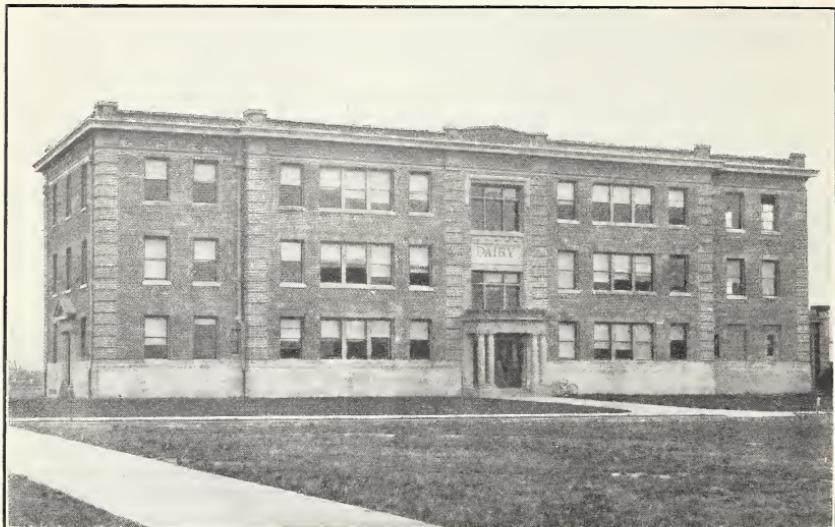


FIG. 1.—DAIRY BUILDING, OREGON AGRICULTURAL COLLEGE.



FIG. 2.—AGRICULTURAL HALL, OREGON AGRICULTURAL COLLEGE.

is to be begun in the near future. A science building, costing \$40,000, is nearing completion at Crookston.

A new mechanics art building, to cost \$260,000, is almost completed at the Minnesota College of Agriculture. There have also been additions made to the dormitories at a cost of \$50,000. (Pl. XII, fig. 2.)

A chemical laboratory, to cost \$60,000 and to be used mainly for agricultural chemistry, is under construction at the University of Missouri. It is to be known as Schweitzer Hall, in memory of Dr. Paul Schweitzer, who was connected with the department of chemistry for nearly 40 years. Two new buildings, a veterinary building (Pl. XIII, fig. 1) and an implement building, have been added during the past summer. The veterinary building is a stone structure, three stories high, 120 feet long, and 60 feet wide. It contains two large operating rooms, a dissecting room, a large lecture room, two large laboratories, and several smaller ones and offices. The implement building is 30 by 80 feet and is divided into eight compartments. The main agricultural building (Pl. XIII, fig. 2) contains administrative offices, classrooms, and library.

A plant industry building, to cost \$185,000, is in course of construction at the University of Nebraska.

A new entomology building has been completed at the New Jersey College of Agriculture. The first story will be devoted to classroom and laboratory work and the second to offices, entomological collections, and the use of the experiment station. The State has appropriated \$100,000 for the erection of an agricultural building.

The poultry husbandry building at Cornell University, for which a State appropriation of \$90,000 is available, is now under construction. A three-story and basement building is planned to accommodate classes of from two to three hundred. The structure is to be 132 feet long, 48 feet wide in the center, and 37 feet wide at the ends.

The first floor (fig. 1) and basement are given over to the practice courses, receiving room, killing room, egg-testing and handling rooms, and the commercial phases of administration. The second floor (fig. 2) contains general and private offices and laboratories, a library and exhibition room, a seminar room, and headquarters for the university poultry association. On the third floor (fig. 3) are a large lecture room, laboratories, a photographic room, and a recitation room. Auxiliary incubator and brooder houses and a judging pavilion are also projected, to be constructed adjoining the building. Plans are being prepared for an auditorium for which \$138,000 is authorized, a heating plant to cost \$50,000, and a general horse barn to cost \$20,000. To make room for the home economics building, for which the State has appropriated \$154,000, the old college barns, built many years ago by Prof. Roberts, have been taken down. A temporary farm mechanics

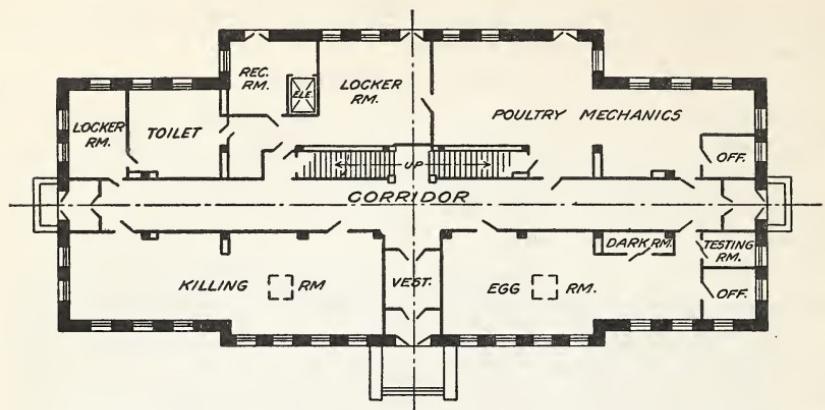


FIG. 1.—First-floor plan, poultry husbandry building, Cornell University.

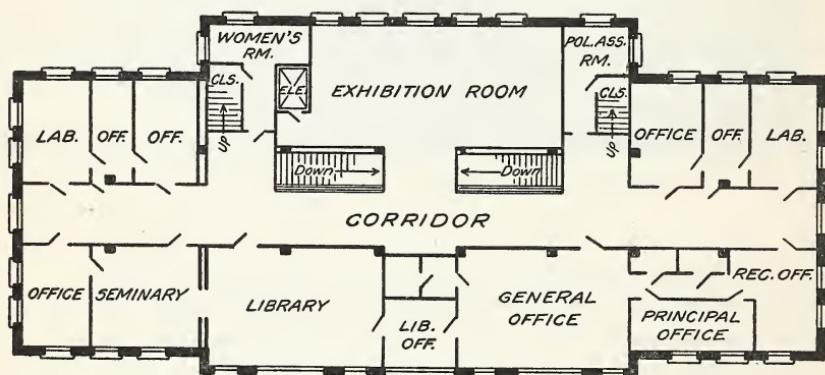


FIG. 2.—Second-floor plan, poultry husbandry building, Cornell University.

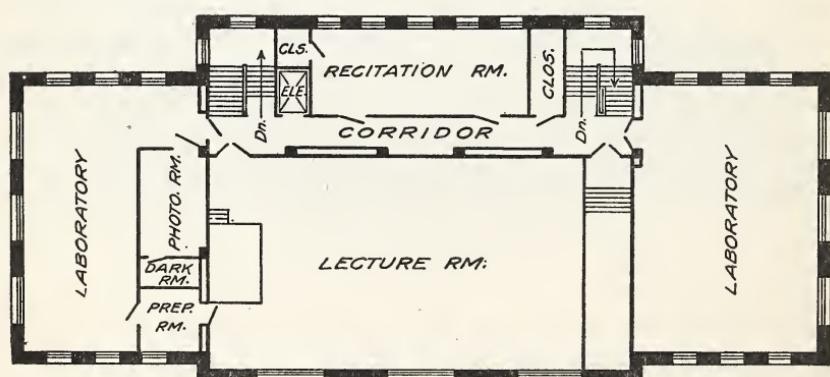


FIG. 3.—Third-floor plan, poultry husbandry building, Cornell University.

laboratory has been constructed and an amphitheater for outdoor classes erected in the park in the rear of the college buildings.

Among the buildings constructed at the North Carolina Agricultural College were an animal industry building at a cost of \$30,000, a dining hall at a cost of \$30,000, and two wings to a dormitory at a cost of \$25,397.

A new dairy building (Pl. XIV, fig. 1) estimated to cost \$30,000 has been completed at the Oregon State Agricultural College. The exterior is of brick and stone and the floor of the first story of concrete. The milk, churning, refrigerator, separator, cream, cheese, and wash rooms, as well as the general offices, will be located on the first floor, and the milk-testing laboratory, classrooms, and shops on the second floor. In addition to the dairy building there has recently been erected quite a number of new buildings, among them an agricultural hall (Pl. XIV, fig. 2), consisting of three sections: (1) Horticultural wing, constructed at a cost of \$45,000; (2) a central building, constructed at a cost of approximately \$50,000; and (3) an agronomy wing, constructed at a cost of approximately \$35,000 (Pl. XV, fig. 1), a farm mechanics building, and a live-stock-judging pavilion (Pl. XV, fig. 2).

The Washington College of Agriculture has purchased the creamery department of a local bottling works, with equipment consisting of three large cold-storage rooms, a manufacturing and ice-cream room, machinery, etc. The college will continue to operate the plant and will also install butter-making machinery. At a recent meeting of the board of regents plans for a \$150,000 building, to be used jointly by the station and the departments of agriculture, horticulture, and extension work of the college, were authorized.

WORK OF THE COLLEGES.

Progress has been made in the organization of new courses of study and the more complete and thorough development of various means of exterior instruction. Country life conferences held at the colleges are growing rapidly.

The division of agricultural education of the University of California has begun the publication of *The Junior Agriculturist*, a semi-monthly leaflet for boys' and girls' clubs.

A new four-year course in agriculture has been outlined at the University of Illinois, whereby the first year's work and one-half that of each semester of the second year will be required. The remaining time will be available for specialization in soils, crops, agricultural teaching, horticulture, farm mechanics, dairying, or animal husbandry. Courses have been added in farm accounting, the economic history of agriculture, and poultry husbandry.

A summer school of five weeks for teachers, offering instruction in agriculture, home economics, and manual training, was opened on June 17 at Purdue University.

During the last biennial period the attendance in the regular four-year college courses at Ames, Iowa, has increased 18 per cent. The total enrollment at the close of the year was 2,509.

A department of public speaking and a new course of study for teachers of agriculture have been organized at the University of Louisiana.

The trustees of the Massachusetts Agricultural College have voted to dissolve the relationship with Boston University, by which the college has, since 1875, constituted the college of agriculture of the university. Plans were adopted for the formal conveyance of the property of the college to the State in accordance with a recent State law declaring the college a State institution.

Minnesota University is encouraging the formation of boys' corn-growing contests, for which prizes aggregating \$600 are available, in addition to a scholarship for one year at the school of agriculture which has been provided by a Minneapolis newspaper. Returns from a blank form sent to each alumnus of the school of agriculture who graduated previous to 1909 show that of the 385 men responding 225 are farming at the present time and the remainder engaged in 34 occupations. Of the 119 women heard from, 60 are housekeepers, 34 teachers, and the balance engaged in 8 other occupations.

The agricultural courses have been modified to give better training to teachers; required work increased in first two years; elective work reduced and put in junior and senior years; and the three-year school of agriculture course has been increased to five years, and includes normal work in the fourth and fifth years with special reference to rural school teaching.

A poultry department has been organized at the Missouri University for both instruction and experimental work in poultry husbandry and poultry diseases.

The State board of agriculture offered a \$100 scholarship in the winter short course to the winner of a contest open to farm boys of the State. In this contest complete records of the milk and butter-fat production of at least three cows for the month of September were kept, and the award was based both on the records themselves and the completeness and accuracy of the reports.

A four-year course for women has been established, leading to the degree of B. S. in agriculture. This includes much of the home economics course with considerable agricultural training and numerous electives. A short course for girls in home economics is also offered for the first time.

Arrangements have been perfected for a permanent forestry summer camp as a part of the required work in the department of forestry. The camp will be located in the Ozark region in the midst of 50,000 acres of native forest lands. Attention will be given to timber estimating, tree planting, lumbering, forest surveying, the laying of logging roads, trails, and fire lines, and the making of lumber and forest working plans.

The New Mexico College of Agriculture held its first farmers' week January 1 to 6, offering lectures and demonstrations in horticulture, agronomy, soils, animal husbandry, dairying, irrigation, entomology, and home economics.

A new plan for the administration of the New York College of Agriculture went into effect January 1. The general supervision of the college remains with the full board of trustees, but the more immediate oversight has been delegated to a special committee of 11, to be known as the agricultural college council. This council is made up of the five trustees appointed by the governor, the president of the university, the trustee elected by the State Grange, the State commissioner of agriculture, the president of the State agricultural society, and two trustees to be selected by the board of trustees, one of these being chosen from those elected by the alumni. The trustees have approved a recommendation from the faculty of the college of agriculture to grant hereafter the degree of bachelor of science instead of that of bachelor of science in agriculture at the completion of the four-year course in the college of agriculture. The work in farm management has been organized as a separate department with G. F. Warren as head professor. The work in farm crops has been united with the department of farm practice and is in charge of J. L. Stone. A department of rural education has been organized, as has also a department of meteorology in its relations to agriculture.

The publication of the Announcer of the College of Agriculture has been begun. This is to be issued monthly with a view to acquainting the people of the State with the work in progress. It will contain notes on investigations and extension enterprises under way, suggestions as to work in rural schools, reading courses, and other lines of interest. A specific object in view is the inclusion of brief summaries of the forthcoming station bulletins.

Announcement is made by the division of agriculture of Syracuse University, established about a year ago in response to the demand "under which every progressive university is put to offer the opportunity for instruction in agriculture as part of a liberal and technical education," of courses in general agriculture, animal husbandry, dairying, horticulture, agricultural engineering, and a special course for teachers.

Entrance requirement at the North Dakota Agricultural College was raised to 15 units, the high-school courses extended from three to four years, and the subpreparatory course abandoned.

Registration in the college of agriculture and domestic science at the Ohio State University has reached 863, making this the largest college in the university, with a gain of 281 over 1910.

At the Oregon Agricultural College a course in highway chemistry has been added to give special prominence to the testing of materials and the study of surface protection of roads.

The University of South Carolina is offering a course of 20 lectures on agriculture in cooperation with this department with a view to affording opportunity for keeping its students in touch with the trend and opportunities of country life.

It is announced that the trustees of Clemson College have authorized the organization of a work-boy course in agriculture. Into this class 20 students were received at the opening of the 1911 session. They will be divided into two squads of 10 men each. One squad will work as laborers on the farm for a week, while the other squad will attend classes. At the end of each week the squads will interchange, and in that way alternate weeks will be devoted to farm work and to study. The course will be completed in two sessions. These boys will receive from 75 cents to \$1 per day. A knowledge of reading, writing, and arithmetic is the only scholastic requirement for admission.

A department of agricultural education has been established in the college of agriculture of West Virginia University, with A. W. Nolan as associate professor of agricultural education at its head. It is planned, among other things, to publish (1) a monthly bulletin on school agriculture, (2) bulletins on nature study for teachers of grades below the seventh, and (3) to cooperate with the county superintendents and teachers in promoting boys' and girls' corn-growing contests.

A department of veterinary science has been established at the Wisconsin University, with Dr. F. B. Hadley as chairman of the department, as well as veterinarian to the station. A small amount of work has been given during the past few years to agricultural students along this line, but this will now be enlarged. The new department has offices, a dispensary, and dissecting and operating rooms in the new live-stock pavilion. A lectureship on country life problems was recently added to the department of agricultural economics, to which C. J. Galpin has been appointed to study rural conditions in Wisconsin, especially with reference to social, religious, business, and educational organizations. The object is to discover the needs of rural communities with a view to starting movements in various localities to remedy unfavorable conditions.

TRAINING OF TEACHERS.

The preparation of teachers to give instruction in agriculture is one of the serious problems confronting the promoters of agricultural education. That and the inability of many schools to pay large enough salaries to retain good teachers are the principal causes that prevent the development of agricultural teaching at even a more rapid rate than that at which it is now progressing. With a view of insisting upon some knowledge of agriculture on the part of teachers, 16 States have passed laws requiring teachers to be examined in this subject, but it has been found that these requirements alone do not solve the problem.

The facilities for training teachers along vocational lines are inadequate. The State normal schools are doing what they can to prepare their students for such work, but the time that can be given to vocational subjects in a year or two in the normal school is extremely limited; and, besides, the normal schools enroll only a small percentage of those who teach in the rural common schools. Their students go largely into the grade work of village and city schools. Out of a total of about 200 normal schools, 114 of those for whites and 13 of those for negroes are giving instruction in agriculture.

In addition to these, there are in Kansas, Michigan, Nebraska, and Wisconsin about 280 high-school normal training courses of one or two years in length, which include some work in agriculture. It is said that a large percentage of those who graduate from these training courses go directly into the rural schools, and while the training they get in this way is by no means adequate, yet it is better than that secured by the average rural teacher. With the State normal schools and these training courses there are now over 400 institutions giving instruction in agriculture to prospective teachers in the elementary grades, and while the meagerness of the instruction they can give in agriculture is to be deprecated, it is nevertheless encouraging to know that something in this line is being done in such a large number of institutions.

Trained teachers for the high-school courses in agriculture are also scarce. The graduates of the four-year courses in the colleges of agriculture find such attractive opportunities in farming, or the salaries offered them by agricultural colleges or experiment stations are so large, that teaching in the public high schools as a profession does not appeal to many of them. The initial salaries offered by high schools may be as good or sometimes better than these graduates could command in other lines of professional or practical work, but the outlook for permanent employment and for increasing returns as the years go by is not so good.

The condition with reference to teachers of agriculture is somewhat better in the special agricultural schools and the subsidized agricultural departments in public high schools than in the ordinary public high schools. In the former the employment of trained teachers of agriculture is usually one of the conditions upon which State aid is given. The permanence of agriculture in these schools is assured, and, furthermore, the funds from the State treasury enable the local authorities to pay relatively high salaries without seriously affecting local taxation. Under such conditions the teaching positions in the vocational subjects are sufficiently attractive to secure the favorable consideration of agricultural-college graduates.

The agricultural colleges are helping to solve the teacher problem. To meet the present emergency among teachers now in service, they are holding summer schools, conducting traveling schools in connection with teachers' institutes, and offering special courses in agricultural subjects for the graduates of other colleges and of normal schools. This undoubtedly is work that needs to be done in all parts of the country.

Recent experience indicates that many of the successful teachers now in service, after taking short courses of a few months or a year devoted almost exclusively to agriculture and methods of teaching it, are likely to become our most successful high-school teachers of agriculture. They have already acquired the high-school point of view, they know the limitations of high-school pupils, and they are not likely to attempt college work in high-school classes. Their college work in a new and inspiring subject of study gives them renewed freshness and enthusiasm, and they readily see the possibilities of agriculture without being led unduly to magnify its importance.

In other ways the agricultural colleges are beginning to make their influence felt in the teaching profession. The Bureau of Education reports that 36 of the colleges for white persons now offer their students some opportunities to fit themselves as special teachers of agriculture for high-school work. Some of these offer only certain courses in general education, elective to students in agriculture; a larger number offer courses in general education and special courses in agricultural education; a few, which have departments of education, allow students in these departments to elect courses in agriculture; while 9 institutions offer prescribed four-year courses for teachers. This feature of agricultural college work has grown rapidly in the past two years, and it will probably develop more rapidly in the future.

Whatever the agricultural colleges may have done in a special way to encourage the teaching of agriculture in high schools, an examination of the statistics of high-school courses indicates pretty clearly that their influence upon this movement has been productive almost in direct proportion to their activity. As evidence of this it may be said

that over 80 per cent of the high schools teaching agriculture are in 18 States having in their agricultural colleges some definite organization—an extension department, a department of agricultural education, a teachers' course in agriculture, or some other definite agency—for reaching the public schools. And if the four or five States were selected which are showing the largest results in public-school work in agriculture, these would be found to be States whose colleges of agriculture have been longest in this field and most active in its cultivation.

Some of the methods by which the California College of Agriculture has aimed to help the teachers are (1) organizing and conducting school-garden work, (2) organizing for encouraging nature study in the public schools, (3) university instruction for teachers, (4) visiting, teaching, and supervising, (5) publishing circulars and leaflets, (6) assisting at teachers' meetings, (7) organizing excursions of teachers to university stations, and (8) organizing boys' and girls' clubs.

During the winter and spring months the College of Hawaii conducted a short course for teachers, including 15 special lectures on Monday afternoons.

The Minnesota State department of public instruction and the extension division of the college of agriculture are cooperating in a systematic effort for the introduction of agriculture into the rural schools this year. A special monthly leaflet from the extension division, called *Rural School Agriculture*, has been sent to every rural school-teacher in the State, with the idea of interesting thereby the boys and girls each month in those things which are being done on the farm and in the home during that month.

The department of agricultural extension of the University of Nebraska has organized two correspondence courses, one in soils and the other in field and forage crops. These courses have been prepared primarily to meet the needs of high-school teachers of agriculture. A collection of laboratory material on field crops designed primarily for Nebraska schools and conditions has been made by the agricultural college.

The students who took the course in agricultural education at the summer session of the Ohio State University have formed an association, known as the Ohio Association for the Advancement of Agricultural Education, which now has members in nearly every county in the State. One feature of the organization is a bureau of information, of which Prof. G. A. Bricker, of the college of agriculture, is director, and the professors in charge of agricultural education in the other State institutions are members. The function of this bureau is to collect and publish information of value to members of the association.

A course in agricultural education extending over four years will be offered next year at the Pennsylvania State College. The primary object of this course will be to prepare teachers of agriculture for secondary schools.

Representatives of the college of agriculture of the University of Wisconsin will soon be stationed in several of the counties of the State, especially those which have training schools for preparation of teachers, to aid in the general agricultural development of the county. In addition to giving agricultural instruction in these schools, the representatives will aid in developing the extension courses of the college of agriculture and will carry on demonstrations on land provided for that purpose by the county. Besides this, it will be a duty to study conditions throughout the county which need improvement, thus standing as a middleman between the college and the farmers.

EXTENSION AND SHORT COURSES.

The farmers' week at the college and the short courses in the State have made marked progress in efficiency. These forms of agricultural extension are educational and inspirational in purpose. The thinking men and women who attend get a broad grasp of the rural problems of to-day and an enlarged vision of the future, while the boys and girls receive practical instruction in vital subjects and some idea of the dignity of agricultural work at a time when impressions sink deep.

Thirty-eight State legislatures appropriated for extension purposes \$384,686.54. In addition to this, \$82,885.55 was used from other sources, making a total of \$467,572.09. Last year the same States contributed \$383,093.47, or \$84,478.62 less.

The extension work during the year has included such enterprises as movable schools, educational trains, country-life conferences, itinerant instructors and advisors, boys' and girls' agricultural clubs, correspondence courses, boys' encampments, demonstrations at State and county fairs, and farmers' institutes. A more detailed account of this work may be found in the report of the farmers' institute specialist, beginning on page 333.

The college of agriculture of the University of Arkansas is now offering 10 correspondence courses in agriculture. Over 325 students are taking these courses, representing 67 counties of the State.

The college of agriculture of the University of Missouri is offering for the first time five-day courses in a limited number of localities in the State, employing two men for the work.

It is announced that the Southern Railway, in conjunction with the Virginia & Southwestern Railway, the Cincinnati, New Orleans & Texas Pacific Railway, and the Mobile & Ohio Railroad, has estab-

lished three agricultural scholarships in the University of Tennessee of \$300 a year for four years. The recipients must be from farms in a county traversed by the Southern Railway system, must be in need of financial assistance, and must agree to practice or teach agriculture for two years after graduation in territory contiguous to some line of the system.

At the suggestion of the station authorities the railroads have this summer been operating excursions from the various counties of east Tennessee to the station to give farmers an opportunity to become familiar with its work. These excursions have proved very successful.

The thirty-ninth annual session of the East Tennessee Farmers' Convention was held on the station farm May 21 to 23, with an attendance of over 2,000. The program was divided into seven sections, viz, general farming, live stock, dairy, poultry, horticulture, home making, and boys' corn clubs.

A notable feature of the convention was the dedication of the new convention hall and live-stock pavilion, in which the larger sessions were held. The building is being erected on the farm through the cooperation of the convention and the station, and will cost when complete approximately \$13,000. It is named the Oliver Perry Temple Hall, in honor of a founder of the association, whose daughter has contributed liberally toward the building fund. The balance of the cost has been provided for by the members of the convention.

THE SECONDARY SCHOOLS.

The largest numerical increase in agricultural courses has been among institutions offering secondary courses, of which there are now listed 2,154, as compared with 630 in 1910. These include 40 privately endowed colleges, more than two-thirds of which are in the Mississippi Valley, 35 State colleges of agriculture offering secondary courses in agriculture, and a large number of agricultural high schools and public and private high schools and academies. Only those institutions reporting students in agriculture as a separate subject of instruction are included, and in the case of high schools and academies which are also doing grammar-school work the enrollment of students of agriculture in one or more high-school years of the course has been the basis for the admission to the list.

Short winter courses lasting six to eight weeks, devoted to subjects of local agricultural interest, have proved very successful, as have also illustrated lectures and demonstrations given in neighboring rural schools on many phases of agriculture. Interest has been aroused and efforts stimulated for a better and more permanent agriculture in the community.

RECENT PROGRESS BY STATES.

CALIFORNIA.

During 1911 and 1912 the Imperial County Union High School, the Oxnard Union High School, the Kern County Union High School, and the Hanford High School established agricultural courses. There are at least five other high schools in which agriculture is being definitely taught as correlated or applied science, viz., those at Gardena, Glendale, Ventura, Santa Cruz, and Yreka. These schools are well distributed over the State, and, together with the University Farm School at Davis and the State Polytechnic School at San Luis Obispo, form the basis of a well-organized system of secondary agricultural instruction. The high-school recommendations of the State country life committee to the Rural Education Conference, held at Davis, October 14, 1911, were revised before presentation to the conference by D. J. Crosby to read as follows:

HIGH SCHOOLS.

(1) Provision for State aid to any free high school establishing a department of agriculture, home economics, and farm mechanics, with courses extending over one or more years, \$250 to be given toward the salary of the first special teacher employed for one of these subjects and \$150 toward the salary of each additional special teacher employed.

(2) Provision for State aid to any high school establishing a department of agriculture, home economics, and farm mechanics, with courses extending over two or more years, \$500 to be given toward the salary of the first special teacher employed for one of these subjects and \$300 toward the salary of each additional special teacher employed.

(3) Provision of \$10 per school per annum for the visitation, by a member of the division of agricultural education of the college of agriculture, of each school establishing and conducting a department of agriculture, home economics, and farm mechanics, for which State aid is asked, providing that a report on each school is filed by said visitor with the State superintendent of public instruction.

KANSAS.

The Kansas Manual Training Normal School, Pittsburg, Kans., offers agriculture as an elective in the third year of its normal secondary courses, and also conducts a two-year normal college course with one semester each of instruction in soils, plant husbandry, animal husbandry, farm manufactures, and agricultural bacteriology. This college course also includes zoology and botany as required subjects, and biology, physics, and physiography as electives.

The institution also offers both secondary and collegiate courses in domestic science and art, the secondary course extending over four years and the collegiate course two years.

MARYLAND.

A feature of the work of some of the agricultural schools in the State of Maryland during the year 1912 was the development of brief

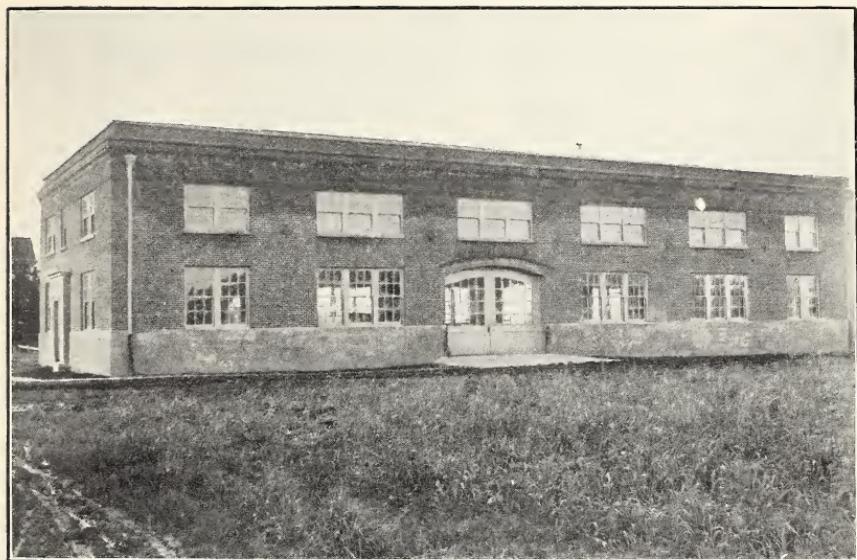


FIG. 1.—FARM MECHANICS BUILDING, OREGON AGRICULTURAL COLLEGE.

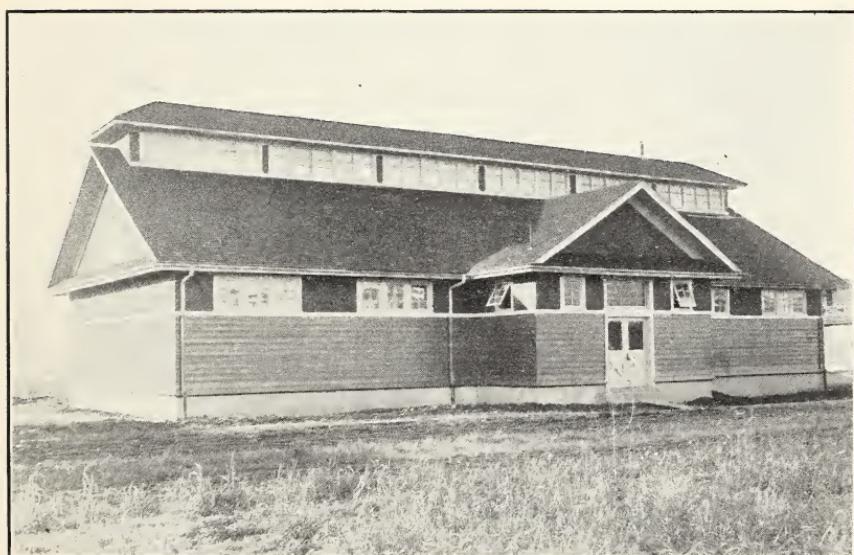


FIG. 2.—LIVE-STOCK JUDGING PAVILION, OREGON AGRICULTURAL COLLEGE.



FIG. 1.—SANDY SPRINGS HIGH SCHOOL STUDENTS ESTIMATING VALUE OF TREES.



FIG. 2.—A LESSON IN FORESTRY, BALTIMORE COUNTY (MD.) AGRICULTURAL HIGH SCHOOL.



FIG. 1.—GIRLS' DORMITORY, SCHOOL OF AGRICULTURE, MORRIS, MINN.

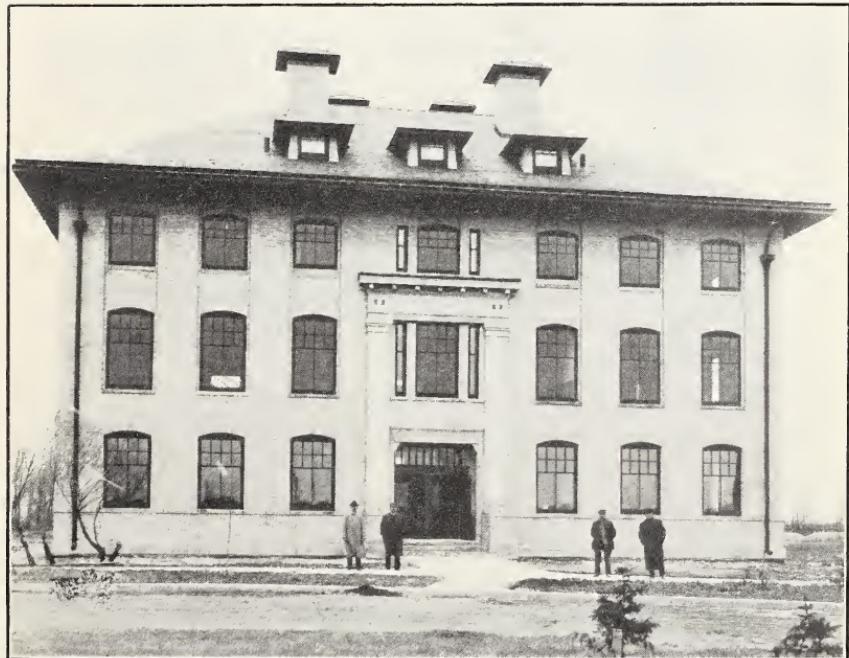


FIG. 2.—AGRICULTURAL HALL, CROOKSTON, MINN.

courses in wood-lot forestry, under the direction of the Forest Service of the United States Department of Agriculture. The schools in which such courses were given were the high schools at Sandy Spring (Pl. XVI, fig. 1) and Brookeville, and the Baltimore County Agricultural High School at Sparks. As a basis for the course in each instance a manuscript prepared in the Forest Service was used as the text. A sufficient number of typewritten copies of this manuscript were prepared and bound for the use of students. In the first two of these schools the work was done at the regular time allotted on the school programs to the subject of agriculture, with the addition, however, of several field trips. The regular work of the schools was not interrupted except that each field trip occupied an entire half day.

The work at the Baltimore County Agricultural High School (Pl. XVI, fig. 2) was conducted on a somewhat more ambitious plan. Here the class, consisting of 10 boys, in the upper grades of the high school spent 10 days at a permanent camp in the woods near Parkton, Md., on a tract of rough, wild timberland, the use of which was generously granted the school by the owner. During the entire period, practically the whole time of the students was given over to the study of forestry. The mornings were devoted to study and recitations, using the manuscript provided as the text. The afternoons were devoted to field work, consisting first of identification of the local tree species and studies of their silvical qualities and habits, such as rate of growth, light relations, soil and moisture requirements, and reproductive powers and habits. Then sample areas were laid off in the timberland near the camp, plans were made for improvement cuttings, measurements made of the trees, and estimates made of the stands according to various systems.

The aim of all the studies and exercises was chiefly to give the students the proper point of view with reference to the farm wood lot; to teach them to consider the trees not merely as something to be cut down and consumed as the owner has need of them, but as a crop which may be perpetuated and improved by proper management.

The manuscript which was used as a text by the students in these experimental courses has been revised in the light of the experience gained by its use in this manner, and will be published in the near future by the Department of Agriculture.

MICHIGAN.

Among the recommendations of the State Commission on Industrial and Agricultural Education are (1) the provision of at least one high school with a four-year course in each township; (2) the introduction, as soon as possible, of agriculture, manual training, and home economics into all high schools; (3) certification of all teachers of agricultural and industrial subjects; (4) State supervision of all agricultural and industrial courses; and (5) State aid for schools introducing

high-school courses in agriculture and home economics, as follows: (a) The total not to exceed \$30,000 for the first year, \$50,000 for the second year, and \$100,000 for any subsequent year; (b) an equal division of the funds between agriculture and home economics on the one hand and industrial courses on the other; and (c) schools certified for aid in agriculture and home economics to receive \$500 for the first teacher employed and \$250 for each other teacher employed, and no school to receive more than \$1,000 in all.

MINNESOTA.

The inspector of State high schools reports that there are 73 high schools offering work in agriculture besides the 10 under the Putnam Act. He states that the weakest school has done good in the community, justifying its establishment, while the stronger schools have exerted an influence that almost deserves the term collegiate.

A girls' dormitory (Pl. XVII, fig. 1), costing \$50,000, has recently been completed at the Morris Agricultural School and a science building (Pl. XVII, fig. 2), costing \$40,000, at the Northwest School of Agriculture, Crookston, is ready for occupancy.

MISSOURI.

The Third District Normal School, at Cape Girardeau, in addition to its regular courses for teachers, is conducting an agricultural high school. The work includes (1) a four-year secondary course intended to fit young men either for farm life or to enter an agricultural college; (2) a boys' short course, running six weeks in winter and confined to farm mechanics and agricultural science; and (3) a school for farmers, lasting from 10 days to 2 weeks.

NEW YORK.

The Chautauqua Institution at Chautauqua has added a school of practical agriculture to its other activities. Hereafter agriculture will be taught both as a course in the regular summer schools and in the new school, where students will live on the new 110-acre farm near the institution grounds.

It is announced that the school will be equipped as rapidly as possible with pure-bred animals and improved machinery, and that suitable buildings will be erected in the near future. Some of the buildings, notably the poultry houses, are to be constructed by the students. They will also be given an opportunity to participate in the farm operations.

A State school of agriculture has been authorized to be located on Long Island, with an initial appropriation of \$50,000.

The 60 acres of land connected with the school of agriculture at St. Lawrence University grew about enough grain and forage the first

year to keep three horses, but the third year saw \$941 left after paying every dollar that went into seed, fertilizers, and labor. This increase, according to the dean of the school, has had more to do with putting the institution on its feet than all the talking he could do.

NORTH CAROLINA.

The State Normal and Industrial College of North Carolina has organized an agricultural department. This includes particularly such work as will be useful for the women and the teachers of the State—landscape gardening, dairying, school gardening, poultry raising, etc. The college is also cooperating with this department in its farm demonstration work, and especially in the organization of tomato clubs.

NORTH DAKOTA.

At the 1911 session of the North Dakota Legislature provision was made for the establishment and maintenance of a department of agriculture, manual training, and domestic economy in State high, graded, and consolidated schools.¹ To derive aid to the extent of \$2,500 each of these schools must, among other things, employ trained instructors in agriculture, manual training, and domestic science, and have within 1 mile of the school buildings not less than 10 acres of land suitable for a school garden and purposes of demonstration.

Provision was also made for the establishment of county agricultural and training schools and their joint maintenance by the State and the county wherein they are located. The yearly cost of maintenance of each of these schools is not to exceed \$6,000 per year, of which the State pays one-half and the county the remainder.

OKLAHOMA.

Under the Oklahoma laws of 1911 the district agricultural schools at Warner, Tishomingo, Broken Arrow, Lawton, and Helena are each to receive State aid to the extent of \$17,000 for 1912 and \$19,000 for 1913, while the more recently organized school at Goodwell will receive during the same years \$11,000 and \$13,000, respectively.

PENNSYLVANIA.

L. H. Dennis has been appointed expert assistant in agricultural education in the State department of public instruction, to supervise the introduction of agriculture into the township high schools.

SOUTH CAROLINA.

The seventh annual report of the commissioner of agriculture, commerce, and industries of South Carolina includes a report of a

¹ U. S. Dept. Agr., Office Expt. Stas. Rpt. 1911, p. 332.

special commission appointed by the General Assembly of South Carolina to investigate and report upon the advisability of establishing and maintaining agricultural schools and branch experiments stations in the State.

In this report the commission enumerates the various forces at work in South Carolina to improve agricultural methods, and recommends that instead of establishing separate agricultural high schools the State create a commission on agricultural education, to consist of the State superintendent of education, the commissioner of agriculture, one member of the board of trustees of Clemson College, the director of the agricultural department of the college, the professor of secondary education of the University of South Carolina, and the professors of elementary agriculture and elementary education at Winthrop College. This commission would be charged with making and executing general plans for agricultural education in South Carolina, including the appointment of a director of agricultural education, who should be an officer of the State department of education, and may be a professor in Clemson College. The duties of this officer, as outlined by the commission, would be to coordinate and harmonize all of the forces now directed toward agricultural education in the schools of the State, prepare and distribute among the schools special bulletins outlining definite work to be done, give specific directions to teachers of agriculture, distribute seeds to schools, and perform such other duties as the commission may direct.

The commission also recommends that special courses designed to prepare teachers of agriculture for the elementary and secondary schools be offered by Clemson College, Winthrop College, and the State University, and that teachers who have thus prepared themselves to teach agriculture and who have received the proper credentials for such work should receive from the State appropriation a small compensation in addition to the salary paid by the district trustees.

Under this plan the work to be done by the director of agricultural education and the commission on agricultural education is to be supported by State appropriations.

WEST VIRGINIA.

A school of agriculture and domestic science of secondary grade has been formally organized at the West Virginia University. For men there is a 4-year course, a short course consisting of two winter quarters, and a winter "farmers' course" of about two weeks consisting of popular lectures, demonstrations, and exercises for men over 21 years of age. The 4-year course consists of three years of two quarters each (for the current year extending from September 18, 1911, to March 22, 1912) and one year of three quarters. During the last year the work in agriculture is elective, and there is also an

opportunity to take three hours each quarter of electives in other subjects. This course is planned for young men who expect to go back on farms, but it also contains sufficient work in English, mathematics, science, and German (two years) to admit its graduates to the college of agriculture with only two entrance conditions.

In the short course all of the work is in agriculture and related sciences. The work of the first winter is the same for all students, but in the second winter students have the option of a group in dairying, a group in horticulture, and a group in animal husbandry.

For women there is a 3-year course in home economics, each year consisting of two terms of 12 weeks each as in the case of the first three years of the agricultural course. The regular academic work for women is the same as that for men, but instead of required work in agriculture they take cooking, sewing, hygiene, music, and home management. They may also take work in dairying, farm crops, and plant propagation instead of German in the third year.

THE ELEMENTARY SCHOOLS.

No educational problem in recent times has been so courageously and so widely attacked as the rural-school problem. European examples have been studied for what they are worth, and each step in America has been examined with care before the next step was taken. The following report of the work in California, by E. B. Babcock, of the University of California, is in a measure representative of what is being attempted for the rural schools in almost every State:

During the year the progress of elementary school agriculture in California has been greater than was anticipated. In the grammar schools the teaching of agriculture is being introduced in many counties, but still too commonly on the textbook basis only. This seems even more apt to be the case among rural schools than in cities where the value of school gardens was earlier recognized. The rural schools are still charged with failing to fulfill their best mission because they do not seek to interest and instruct in rural pursuits. This is an indictment of the schools, not of teachers only, or of trustees, or superintendents. But it is generally conceded that the rural school needs to be modified somewhat in order that they may best serve the State.

The welfare of the community at large demands better agricultural practice now and hereafter. It is agreed that the rural schools offer the best means for presenting to the individual farmers of to-day, through their children, some of the fundamental principles of farming that are not now properly appreciated and observed by farmers. Moreover, it is believed that by means of instruction in gardening, nature study, and agriculture in both city and country schools a growing sentiment in favor of country life and rural occupations will be generated.

A rural education conference was held at Davis to listen to reports on what is being done and to discuss ways and means for improving the instruction given to children and youth living in the country. The avowed purpose of the Davis convention was to arrive at some conclusions with respect to redirection of our rural schools. It is generally assumed that this means the introduction of agriculture as a principal study. Certainly the time has come to provide vocational training, but many difficult problems must be solved before the public schools will all do this satisfactorily. However, the

introduction of practical agriculture in our grammar schools, by means of garden and field practice as a working basis, seems more feasible than any other step thus far contemplated. But the proper presentation of agriculture in our grammar grades presupposes a satisfactory course in nature study leading up to it through the primary grades. The division of agricultural education of the college of agriculture has prepared a general plan for such a course including grammar grade agriculture and showing how all the work should be based upon practical training in garden and field.

GENERAL PLAN FOR—

NATURE STUDY.

GARDEN AND FIELD WORK.

GRADES 1 AND 2.

Observations of a wide range of natural objects and phenomena, selected as types.

Begin by watching older children and helping when possible. Then community plots for special purposes.

Second grade.—Individual gardens with large-seeded vegetables and flowers.

GRADE 3.

Essentially "Home geography" studied out of doors as much as possible. Local sources of food, clothing, and building material and industries connected with production of those things. Birds, rodents, weather, etc., as related to these activities.

Community work: (1) The care and improvement of home and school premises, simple ideas of landscape art; (2) grow some of the food plants grown in locality.

Individual work: Smaller seeded vegetables with emphasis on planting, thinning, transplanting, and cultivation.

GRADE 4.

Closely correlated with geography, with emphasis on the economic or commercial phases. Useful plants and animals, especially those produced in California, studied in a more detailed way than in the lower grades, including crude operations of manufacture performed in school of such products as sugar, flour, corn meal, corn oil, rubber, crude fiber, etc. Visits to manufactories where man has perfected machinery for making these products.

Community work: Culture of *typical* crop plants—wheats, barleys, oats, sugar beets, varieties of maize, flax, mulberry trees, etc.

Individual work: Raising of rarer vegetables for sale—endive, cauliflower, kohlrabi, Brussels sprouts, chard, salsify, etc. Establish market at or near school. Have a school bank. Correlate manual training, arithmetic and language. (In this and other grades see circulars 46 and 62 of College of Agriculture, Berkeley.)

GRADE 5.

Intensify on tree and bird study. They go well together. Frequent excursions, if only to nearby streets and parks. Learn to recognize trees by bark, leaves, flowers, fruits, seeds. Collect seeds or seedlings for use in school garden or for exchange. Elementary forestry. Learn to recognize birds by appearance, habits, movements, songs or calls. Classify in various ways, keep diaries and make list of migratory birds with dates. Observe food of birds and note relation to agriculture.

Experiment with germination of tree seeds: Various sizes and kinds from eucalyptus to coconut. Apply knowledge gained to business of raising most desirable trees and shrubs for locality for use on school or home grounds, streets, parks, or country roads. Make cheap but efficient guards and *care for trees after planting*. Make flats, stakes, shipping crates, etc. (See Circular 59, Agricultural College, Berkeley.) Start a nursery of fruit and nut trees for use next year in plant propagation.

GENERAL PLAN FOR—

NATURE STUDY.

GARDEN AND FIELD WORK.

GRADE 6.

Elementary experimental study of the plant: How it lives and grows; experiments suggested in Elementary Agriculture, a Teachers' Manual to accompany Hilgard and Osterhout's Agriculture for Schools of the Pacific Slope.

Plant propagation: Make and root all sorts of cuttings. Application of knowledge gained to *seedage* and *graftage*. Bud and graft fruit and nut trees planted previous year. Divide and plant offsets from old bulbs; if there are none, plant mature and young bulbs in variety and raise freesias, gladioli, or lilies from seed. Each pupil choose some vegetable or flower to improve and begin work at school or home.

The work in the following grades should be optional for pupils but offered in all schools containing these grades.

AGRICULTURE.

GARDEN AND FIELD WORK.

GRADE 7.

Study portions of Hilgard and Osterhout's text. Make excursions to various kinds of ranches. Organize an agricultural club. Choose a topic for general study, such as poultry raising, orange growing, or whatever is of interest in the community. Have individual reports on plant improvement work, new inventions in agricultural machinery, plans for local, county, or State fairs or contests among members.

Gardens or field work at school and at home. If pupils have not had experience in gardening, some of the work suggested for grades 3, 4, 5, and 6 should come first.

At school, plat experiments with fertilizers, green-manure plants, variety tests of crops grown in the locality, and crop rotation. Continuation of plant improvement work begun year previous. Planting and care of fruit and nut trees propagated last year.

At home, individual problems.

GRADE 8.

Complete Hilgard and Osterhout's text. Supplement with practical works and United States and Experiment Station publications.

Continuation of fertilizer and crop rotation experiments. Orchard practice. Live stock husbandry. Farm engineering.

It remains to suggest ways and means by which the introduction of this plan may be accomplished. A special subcommittee of the State country life committee has prepared the following recommendations which were presented to the rural educational conference:

ELEMENTARY SCHOOLS.

I. Immediate recognition of nature study and agriculture by county boards of education in three ways, as follows:

(a) During the years 1912 and 1913, adoption in all agricultural counties of a well-organized course in nature study and agriculture for all grades below the high school; the work of the grammar grades to be closely correlated with the leading agricultural industries of the region and vocational in nature.

(b) The provision of county or district supervisors of nature study and agriculture, who are to be paid by setting aside a certain percentage of the income of each school

district. Until a new State law makes it possible these supervisors can not be paid by counties out of unapportioned funds. They must be employed by agreement among the trustees of the several school districts interested.

(c) Provision for proper presentation of agriculture to teachers' institutes and county trustee conventions.

II. Increased attention to be paid to the preparation of teachers and supervisors of nature study and agriculture by the State normal schools and the University of California.

III. Legislation covering the following points:

(a) Beginning in 1914 make nature study and agriculture required studies in primary and grammar grades—agriculture to be introduced not later than the fifth or sixth grade with vocational agriculture offered, but optional to the students in the seventh and eighth grades.

(b) Beginning in 1914 candidates for the county teacher's certificate to take examinations in nature study and agriculture.

(c) Provide for the division, not later than 1914, of all counties into districts for the supervision of vocational education, including agriculture, in the grammar grades. These districts should contain not more than 50 schools, preferably less.

(d) Beginning in 1914 provide State aid for any grammar school teaching vocational agriculture as was provided in the Weinstock industrial bill.

D. J. Crosby, of this office, who was in attendance at the conference, was inclined to delay somewhat longer the compulsory teaching of agriculture and nature study, and try to hasten the preparation of teachers by giving those who successfully teach these subjects a small bonus—this in lieu of State aid to grammar schools. He therefore suggested the following revision of the above recommendations:

ELEMENTARY SCHOOLS.

III. Legislation covering the following points:

(a) Provision of a fund for the payment of a bonus to every grammar-school teacher who during the year 1913 or any succeeding year, shall, in the judgment of the proper supervising officers, successfully teach vocational agriculture.

All the above recommendations are only details which must receive due consideration if our policy is to be carried out by actually introducing the course above outlined. Some may obtain the notion that this is an attack upon the foundations of liberal education, but nothing is further from our thought. In the first place none of the work proposed for primary grades may properly be called vocational. It is generally agreed that a first-hand knowledge of nature is an indispensable part of a broad foundation for a liberal education. Moreover, while the vocational agriculture proposed for the grammar grades should prove invaluable to the future farmer, it may serve to supplement the other training of any citizen and will serve to make him more intelligent regarding the fundamental occupation of mankind.

FARMERS' INSTITUTE AND AGRICULTURAL EXTENSION WORK IN THE UNITED STATES, 1912.

By JOHN HAMILTON,

Farmers' Institute Specialist, Office of Experiment Stations.

Reports of the farmers' institute work for the year ended June 30, 1912, were received from all of the States excepting Virginia and the island of Porto Rico. Institute meetings were held in all of the States and Territories excepting Nevada, Alaska, and Porto Rico. Although no institutes were reported for Louisiana, meetings of institute character were conducted by the agricultural experiment station as a form of college extension.

INSTITUTES HELD.

The total number of institutes held during the year was 7,598. These were made up of 5,328 one-day meetings; 2,015 two days, and 247 three or more days, an increase over the previous year of 1,380 one-day meetings and 288 two-day. There was an increase in the three or more day meetings of 33. The whole number of days of institutes held in 1912 was 10,191, an increase of 2,146 over the year 1911.

SESSIONS.

The number of sessions was 19,430, or 2,689 more than were held in 1911. This large increase is the more significant since taken in connection with the average attendance per session it measures accurately the progress of the work. It shows an advance of more than 16 per cent over the sessions of the previous year.

ATTENDANCE.

The attendance reported at the regular institutes was 2,549,199, with an average of 131 persons per session. This shows an increased attendance over the previous year of 257,342. While under the system adopted by the American Association of Farmers' Institute Workers for computing attendance duplications occur, yet the totals serve for comparison with those of previous years. When, however, the total number reported in attendance is divided by the number of half-day and evening sessions held, error is eliminated and the progress of the work is accurately shown.

APPROPRIATIONS.

The appropriations from all sources for institute support in 1912 amounted to \$533,972.09, an increase of \$101,278.62 over 1911. The appropriations by the State legislatures were \$439,186.54, and from other sources \$94,785.55. The amount expended in carrying on the work was \$487,832.17, or an average of \$25.10 per session of institute, as against \$25 in 1911. The amount appropriated for institute purposes for 1913 by 35 States reporting is \$409,525.

AGRICULTURAL COLLEGE AND EXPERIMENT STATION AID.

Thirty-eight of the agricultural colleges and experiment stations furnished from their faculties and staffs 474 lecturers, who contributed 6,018 days of time to institute instruction. This is an increase of 129 lecturers and 1,759 days of service over the previous year. The figures show that the colleges and stations are alive to the importance of this work, and notwithstanding the large increase of resident students in their institutions are sending out more men into the institute field and are giving more time to this form of instruction each year. The average time given to institute work by each college or experiment-station lecturer in 1912 was 12.7 days; in 1911 it was 12 days.

SPECIAL INSTITUTES.

Movable schools of agriculture and home economics were held in 14 States. The total number of these schools was 164, occupying 829 days of time, with a registered attendance of 137,669, an increase in attendance over the previous year of 89,234.

Fifty-four educational trains were run in 24 States. Twenty of these States reported 310 lecturers accompanying these trains, and a total attendance in 23 States of 1,033,735. Two thousand one hundred and six stops were made at which meetings were held, and 41,991 miles of road were covered.

Independent institutes were held in 17 States to the number of 609. There were 971 sessions, with an attendance of 138,598. Seventeen round-up institutes embracing 166 sessions were held in 17 States, with an attendance of 46,464.

Four hundred and fifty-nine fairs, picnics, and conventions were visited and addressed by institute lecturers, with a total attendance of 123,881. Fifty field demonstrations were given by seven expert demonstrators, the attendance not reported.

The aggregate attendance at all of the special institutes reported was 1,480,347, making the entire attendance at institutes of all kinds for the year 4,029,546.

FARMERS' INSTITUTES FOR YOUNG PEOPLE.

One hundred institutes for young people were held in 5 States extending over 107 days and consisting of 163 sessions. The attendance is reported at 14,245. Two States conducted 28 movable schools for young people. The schools covered 121 days, and had a total attendance of 6,054.

Many institute directors do not yet seem to appreciate the importance of institutes specially adapted to young people of the ages of 14 to 18. It must be perfectly clear, however, to everyone who has observed the interest taken by boys in their corn-club work and in the boy scout movement, as well as by girls in their home economics and art association work, that young people in the country are ready now to join the movement for increasing their knowledge of agriculture and home economics if institutes adapted to their ages and attainments were organized and judiciously conducted.

WOMEN'S INSTITUTES.

Separate institutes for women were held in 8 States to the number of 720. The States were Michigan, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Utah, and Wisconsin. The institutes embraced a period of 916 days, and occupied 1,375 sessions. The total attendance is given at 78,776. This is an advance over the previous year of 418 institutes, 542 days, 798 sessions, and 30,814 in attendance.

The great progress made during the year strikingly appears if the 8 States reporting work of this character for both the years of 1911 and 1912 are compared. The comparison shows that there has been an increase of 870 sessions, and of 43,767 in attendance in 1912 over 1911. If the 40 other States had organized institutes separately for women there is every reason to believe that equal gains would have occurred in them all, and that many thousands of women now deprived of the privilege and advantage of such meetings would have been greatly aided in their social life as well as in their home economics work. Here, too, there is need for general awakening to the opportunity for service that the organizing of institutes for women affords to the directors in the several States.

MOVABLE AND CORRESPONDENCE SCHOOLS.

One hundred and sixty-four movable schools of agriculture were held in 14 States. The instruction continued through 829 days, with an attendance of 137,669. Ninety-one of these schools were for men and continued over 490 days, with an attendance of 68,511. Forty-five were for women, continued over 218 days, with an attendance of

11,059. Twenty-eight were schools for young people, continued over 121 days and attended by 6,054. Last year 168 schools of this character were held, covering 659 days, with an attendance of 48,465, showing a considerable increase both in days devoted to this work and also in the number in attendance.

These figures do not show the entire amount of movable school work done during the year. In a number of the States this work has been detached from the farmers' institute and transferred to the extension departments of the agricultural colleges, and therefore does not appear in the institute report. The statements made show, however, that the work is growing rapidly and is supplementing the old form of institute by devoting longer periods to instruction in the localities where the meetings are held. It must be confessed, however, that in but few instances have they met the standard for movable school work set by the Office of Experiment Stations. Much of the instruction is still fragmentary and somewhat superficial. It would be greatly to the advantage of the movable school enterprise if demonstrations by experts could be had to show precisely how the system proposed can be most efficiently operated.

Similar demonstrations showing the practicability of conveying information by means of the method of correspondence outlined in last year's report of the institute specialist are likewise needed. A few demonstrations carefully conducted along the lines there proposed showing how agricultural instruction of high grade can be given to men and women of average intelligence, but having experience in the practical operations of farm and home economics, would be of great service in convincing the State institute directors and extension workers of the practicability and value of the method.

ITINERANT WORK IN TEACHERS' INSTITUTES AND RURAL SCHOOLS.

The farmers' institutes in a number of States have been detailing lecturers to address school teachers at their county institutes and conventions. Also to visit the normal schools, high schools, and common schools to speak to the students on subjects related to agriculture and rural life.

During the past year 12 State directors reported that 55 of their instructors had given 371 days of time to teachers' institutes and that they had met in these institutes a total of 32,642 persons. Four hundred and five men gave 612 days to high-school instruction, meeting 91,705 persons; 9 men gave 21 days to instruction in the normal schools, meeting 2,050 persons; 42 men devoted an aggregate of 2,953 days to lecturing in the rural public schools, meeting 72,379 children; 74 men gave 3,796 days to itinerant work among farmers,

giving advice and conducting demonstrations; and 18 men gave 2,350 days to other forms of extension work.

The effect of efforts in these several directions can not be definitely known, but that they are productive of great good in stimulating interest among rural people in advanced agriculture and in the betterment of rural conditions is unquestioned.

INSTITUTE ORGANIZATION.

Attention is again called to the extreme importance of a thoroughly organized system in each State for conducting farmers' institutes. This feature has become the more urgent now that the work is developing so rapidly that the demand for institute meetings is out of all proportion to the present ability of the directors to meet them.

During the past year a questionnaire was sent out to the State directors for information respecting the forms of organization under which they severally are conducting their work. Thirty-five replies were received.

To the query, "Have you county institute organizations?" 15 replied "yes," 3 "a few," and 17 replied "no."

To the query, "Are your local institute societies organized under any special or general law," 8 replied "yes," and 18 "no."

To the inquiry, "Do you find your plan satisfactory?" 23 replied "yes," 3 "fairly so," 4 "not entirely," and 2 answered "no."

To the query, "Is your work so well organized that subsequent directors can take it up without difficulty and continue it successfully?" 22 replied "yes" and 9 replied "no."

To the question, "Do you regard your system the best or among the best?" 17 answered "yes," 4 answered "no," and 5 "not entirely."

To the query asking for suggestions for the improvement of their systems, 17 responded. The suggestions were mainly for better local organization, additional appropriations for conducting the work, and better qualified lecturers.

It will be observed that the methods of conducting the work vary quite considerably, extending through several grades of local organization down to none whatever. As a rule, the directors seem to be well satisfied with whichever form they happen to have, since out of 32 to whom the question was put only 2 answered "no."

In discussing the point of efficiency in the annual report of the institute specialist for 1910, the necessity for greater economy in the expenditure of institute funds by many of the directors was emphasized. It was shown that if the same economy were exercised by all as is practiced by 18 of the States, over 60 per cent more institutes could have been held with the money at the disposal of the directors that year. This example is but one of several that might

be presented showing the need for the study of "efficiency" by institute directors. In all departments of business the problem now is how to secure greater efficiency, and the road to this has usually been found to be along the line of systematizing the work so as to reduce lost motion to a minimum.

The same need of better organization and methods that we now experience is being felt by State officials in other countries. Something over a year ago the Board of Agriculture of India appointed a committee to consider the whole question of local organization. The committee made its report in January, 1912, and its conclusions are so pertinent to our conditions that a portion of the report is here given for the information of the State directors and others interested in the efficiency side of our institute work. The report says:

It might be, and has indeed been asked, whether it is either necessary or advisable to encourage such local bodies (agricultural organizations) as we are discussing. Can not the Agricultural Department communicate directly with the cultivators? Is not such communication with and giving help to individuals of equal value with work done by and through an association? The committee venture to express a decided opinion that while this *can* be done, while it is *possible* to deal direct with every cultivator in the districts, yet this is not generally the best or most economical way of proceeding. A local organized body is a far more efficient agent for the introduction of improvements than the few officers of the Agricultural Department working individually can ever be, for, being a body of local men, it carries considerable local influence if composed of right people; the members can and do mutually encourage one another, while its educative value in combined work and cooperative effort is, if properly organized, greater than can be realized. Even if the same end can be gained, so far as the introduction of an improvement is concerned, without a local association, the committee feel that, provided conditions are favorable, a better final result is attained if a local body as such takes a share in the matter, as this tends to increase the cooperative spirit of the people, and hence the likelihood of permanent advance.

Success with such associations can, however, only be reached by following certain lines which can now be laid down with some approach to certainty. However organized, it is necessary that—

(1) Every local association should have a definite work to do, and the members should feel responsibility for taking a share in it. It has not been at all unusual for an association to fail because the members have not been responsible for any work. Again, the first question asked by a local body, however got together, is "What shall we do?" Unless the organizers of every single association—generally the Agricultural Department—have definite work which can be placed in the hands of the members, within their capacity and yet capable of arousing their interest and keenness, it is extremely unwise to attempt any organization whatever.

(2) A local association should be composed of men who are really interested—and practically interested—in agricultural improvement in the area in question. Associations have perhaps more often failed on account of the neglect of this matter than for any other reason. The members had but an academic interest in the subject, became members because of social or other reasons, and did not take the work seriously.

(3) The work of a local association should be regularly inspected, examined, criticized, and the association called together. The committee wish to lay great stress on this matter, and desire to state that they consider that a considerable part of the

increasing efficiency of the system in the central Provinces has been due to the care which is taken in this matter. It undoubtedly involves on the part of the Agricultural Department (or a central body of some sort) a considerable expense for inspecting officers, but without this it may be stated with certainty that the result will not be a success except in rare cases. The Agricultural Department must, the committee feel, *aim at having a subordinate staff of high quality for this purpose*.

(4) The members of a local association must, even apart from inspections, be made to feel that the Agricultural Department is interested in them and their work. It is wonderful how regular correspondence, prompt attention, and general evidence of interest and support encourages both the individuals and the associations of which they are members. If agricultural associations are to be a success, this must be arranged for at any cost.

This statement, made after most careful consideration by a committee of experts, is worthy of thoughtful attention by the institute directors of the United States. It emphasizes the absolute need for local organization if work of this character is to be efficiently performed. The sooner institute directors come to appreciate this the sooner greater efficiency and economy in conducting the work will be secured. The matter of the extent of territory that each organization should embrace is one of very great importance and needs to be considered in any plan that is proposed for the formation of a general system of farmers' institutes in a State.

THE TOWNSHIP UNIT OF ORGANIZATION.

It has been very clear for some time that the county unit of organization for institute work is too large for rendering proper service to the various communities. In the early stages of institute effort this was all that could be undertaken. Now that the work has become better systematized and is no longer experimental, the subdivision of the county has become necessary if the beneficial effects of the institute are to reach the mass of agricultural people. In one or two States the township unit has been adopted, and in another township lines have been disregarded and the community unit has been taken instead. The former plan has recently been adopted by the State of Indiana. In that State there is a county organization known as the county institute board composed of the chairmen of the several township institute associations. This board elects annually a county chairman and a county secretary. The institute board has general charge of the institute work in the county and advises with the extension department of the State with respect to the dates and subjects desired for institute meetings. The places of meetings, however, are determined by the local or township institute associations and not by the county organization.

The local association is a township organization with a chairman, secretary, treasurer, and an executive committee composed of five persons—three men and two women. There is an annual county

meeting to elect a county chairman and secretary, and for the discussion of the general work of institutes in the county. The membership fee for the township society is 25 cents per year and there must be at least 25 members to secure a speaker from the State department. Women speakers go out upon application where 15 or more women request the service and are members of the township society. The extension department pays the per diem of the speakers and their railroad and steamboat fares to and from the railroad station or steamboat landing at or near the place of meeting. The local association must agree to pay their local expenses, such as bus and street-car fare, baggage transfer and livery hire from the railroad station or steamboat landing to and from the place of meeting; also lunches, hotel bills, etc., while in attendance at the institute.

The director in inaugurating the plan calls attention to the importance of cooperation for effective work. He states: "That by the localizing of interest in the home neighborhood due to the smaller unit of organization the solid backing which these organizations will give to their respective chairmen and the closer contact of the local association with the extension department, effective team work in promoting agricultural interest is now possible."

Where the above method of bounding the unit by township lines is not practicable owing to physical obstructions such as rivers or mountains, or to sparsely settled communities, the unit may be formed by communities utilizing their business centers as headquarters for the association. The general fact, however, is now apparent that some method of subdividing the counties into smaller communities is necessary for most effective work.

An organization similar to the above was recommended by this office at the tenth annual meeting of the American Association of Farmers' Institute Workers and published as a separate by the Office of Experiment Stations.¹

ORGANIZATION OF FARMERS' CLUBS.

Under the township unit plan there is made possible also a still further subdivision, namely, the farmers' club or rural family club, consisting of from 8 to 12 families joined in a mutual association for social as well as educational and business purposes. The Indiana plan contemplates the organization of these clubs as subordinate to the township institute. The township institute would probably not convene oftener than three or four times a year, but the local clubs could meet biweekly or monthly, as might be convenient. A constitution and by-laws for such clubs was also prepared by the

¹ U. S. Dept. Agr., Office Expt. Stas. Bul. 165, pp. 78-94.

institute office of this department and is published in the document just referred to.

Under such a system it will be possible to reach all of the communities, and indeed all of the agricultural people of a State within 24 hours, or as soon as the mails can carry information. In this way the work will be thoroughly systematized and agricultural information can be disseminated regularly and topics of importance can be suggested for discussion simultaneously at all of the institutes and farm clubs held throughout the State.

THE UTILIZATION OF THE INSTITUTE FORCE.

If the work of the farmers' institute is to expand as the needs of the people demand then a much larger number of persons will have to be employed in the work of disseminating information than are now upon the institute force. The institute has drawn in the past very largely upon agricultural college and experiment station people for expert assistance. It is becoming more and more difficult for these institutions to supply men for this service without seriously interfering with their regular work of instruction and research in the institutions. It is therefore of first importance that the institute directors make use of laymen to the extent of their possibilities, and also that they utilize the service of experts from the college extension departments to the greatest possible degree.

There are in all of the States a large number of men and women who have notably succeeded in various lines of agriculture and home economics but are unable, by reason of lack of training, to state what they know in the form of a set address. It is now proposed to utilize these men and women by means of the round-table method, where the individual will be placed on the stand and subjected to questioning by the audience along the lines of his specialty. This avoids the necessity for his presenting a formal paper or address, and at the same time secures to the audience the information that the individual has acquired through a lifetime perhaps of study and experience. Hundreds of men and women could be made serviceable in this way if a proper scheme of questioning were adopted and the individual given an opportunity to tell in an informal way the things desired to be presented.

The other point is the proper utilization of experts who are capable of making formal addresses and of expressing what they want to say in an agreeable and forceful manner. Frequently in the past very little information has been secured from these speakers outside of that given in their formal papers or addresses. It is now proposed that during the time these speakers are on the stand some capable person shall be assigned to make notes of the points that the speaker presents, and at the close of his address, instead of his leaving the

stand, that he be seated and undergo cross-questioning to clear up ambiguous statements or to develop features that he did not fully present. By having the questions prepared by an expert, the cross-questioning would be in no danger of degenerating into unprofitable discussion, and the management would be confident that the period given to this exercise would be fully and properly occupied. It is understood, of course, that members of the audience are at liberty to participate in this cross-examination as they may desire. In this way the full value of a speaker's address will be more likely to be secured, and the points that members of the audience might feel had not been fully explained would be cleared up.

The round-table method, therefore, for men not accustomed to public speaking, and the cross-examination by an expert of the man who is capable of making a set address, are the two features proposed as a partial remedy for the dearth of teachers now experienced in institute work.

FIELD ORGANIZERS.

The field organizer has come to be an important part of the State institute force. If the women's institute, the young people's institute, the local club, and demonstration in field, orchard, or barn are to become realities in any reasonable time, it will have to be made the duty of some one or more persons to effect their organization by visiting the various localities and actively interesting farming people in these forms of association. The same is true of cooperative societies among rural people. Some one well informed as to the details of operation of the particular society to be organized should visit the locality, not only to create interest in the enterprise, but to see that the association is actually organized and properly maintained.

Organizing work of this character is unquestionably within the sphere of farmers' institute activity, and it is its duty as well if it would fulfill in any large way its obligations to country people. The institute is the pioneer in enterprises for the betterment of rural conditions and rural people. Whatever, therefore, is needed to accomplish these ends the institute is, by its official position, under obligation to undertake.

Instead of waiting for the situation respecting any needed reform to become so imperative as to arouse indignant public feeling before a remedy is sought, with the result of hasty and ill-considered action, the institute should study in advance the needs of the various communities and start movements toward meeting these needs in an orderly and effective way. Institute directors can do much to influence public thought and action by studying the problems that affect farming people, and then by sending well-informed men and women out to put into operation measures designed to bring about necessary improvement or reform.

The "field organizer," or "promoter," as the agent of the institute department may be termed, can, by devoting all of his time to the work of organizing societies in the directions needed, in a short time effect that which otherwise would require years to accomplish.

INSTITUTE RECORDS AND REPORTS.

The farmers' institute specialist each year is greatly embarrassed in compiling his report owing to changes occurring in the institute officials in the several States, particularly from the outgoing officials not having kept any systematic record or set of books showing the status of their work—books that their successors could use in gaining acquaintance with what has been done in the past, and in making report either to his immediate chief or to the farmers' institute office at Washington. In numerous instances requests upon State directors for reports are met with the reply that a change in the institute head has occurred during the year and that no record of the work has been kept in the office, consequently the reports either can not be prepared without great difficulty or not at all.

If each State director would open suitable books of record and would require his lecturers and local managers periodically to make to him full reports of their work upon blanks that he would provide and then preserve the information by recording the data in a permanent book of record—the books to be the property of the office and to be left there for use by his successor, the difficulty now experienced in this direction would be in great degree if not wholly obviated. The records could be extended to include also specific instances of the beneficial results of the institutes to individual farmers.

RESULTS OF INSTITUTE EFFORT.

Early in the year a letter was sent out to the State directors requesting them to mention specifically some of the beneficial results of the institute to agriculture in their States. The purpose was to secure if possible reliable data respecting the practical utility of the farmers' institutes in bettering agriculture, and at the same time cause the directors to examine their own work with a view to making it more directly useful to farming people.

Replies were received from 24 State directors. Nine of these stated that while they had no question as to beneficial results to agriculture having been secured through the instrumentality of their farmers' institutes they were for various reasons unable at the time to give specific instances of such benefit.

The 15 others reported as requested, and a number gave quite full accounts of the direct value of the institute to their farmers. Among these benefits are the following:

It has introduced the use of the balanced ration for dairy cows; better sanitary arrangements in the stables; spraying fruit trees for

the control of fungus diseases and insect enemies; the practice of better methods of cultivating crops. Farmers by this means have learned about the use of cowpeas, soy beans, scarlet clover, and other forage plants; have been encouraged in the growing of potatoes and also of crops specially suitable for canning. Have been instructed in the better selection of seeds; the proper use of fertilizers for various crops; how to renew old and neglected orchards; and in the business of poultry rearing. It has reached a class of farmers who do not read; has aroused farmers to the possibilities of intelligent effort in improving their farms. Through their instrumentality corn and potato crops have been increased; the shoeing of horses in the neighborhood has improved; farmers have been encouraged to renewed exertion in the direction of better farming; greater diversification of crops has been effected; young people have been brought to respect agriculture as a profession; the use of lime for correcting acidity in the soil has been explained and adopted; the profitable use of ground limestone has been introduced instead of the caustic form, and the benefit of ground phosphate rock instead of the acidulated has been demonstrated. Interest in scientific farming has been stimulated. The building of silos, the raising of well-bred animals, better systems of crop rotation, soil conservation, a better class of breeding sires—all have been explained and introduced. Cheese factories have been established; the use of concrete in farm buildings has been brought about; farmers have been educated in methods of preventing the spread of tuberculosis among farm animals; communities have been changed from the practice of grain farming to dairy farming; farm clubs, farmers' cooperative associations, cow-testing associations, and breeders' associations have been organized. The use and value of alfalfa have been shown; methods for the conservation of moisture have been introduced. The agricultural-instruction train has been sent out; farmers' homes have been improved; unprofitable cows have been weeded out from dairy herds; the country school and school buildings have been improved; the country road has been made passable, and a large number of capable agricultural lecturers and teachers have been developed.

These items, which together practically cover the entire field of agriculture, are given as proof of the value of the institute to agricultural people. In no instance has any doubt been expressed as to the great value of the institute method of carrying information to rural people, and the constantly growing interest among farmers as manifested in the increasing number who year by year are in attendance upon the institute meetings shows public appreciation in a manner impossible to be misunderstood.

An important general effect has been that upon educators. All from the primary school to the university are now convinced that

agricultural teaching is a legitimate part of the educational curriculum that is to fit men for rural life, and in proof of the sincerity of their belief in this they have introduced this study almost universally into their courses of instruction. This recognition was undoubtedly hastened through the influence exerted by educators who had lectured on institute platforms until they became convinced of the value of the study of agricultural subjects in intellectual training, as well as its great economic importance in fitting men for the pursuit of agriculture as a profession in life.

THE AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

The seventeenth annual meeting of the American Association of Farmers' Institute Workers was held November 11 to 13, 1912, at the Piedmont Hotel, Atlanta, Ga. Representatives were present from 36 States and 2 Provinces of Canada, from Porto Rico, and the District of Columbia. Seven of the standing committees presented reports. The committee upon institute organization and methods recommended a change of the unit of organization from the county to the township or the community, holding that more people should be reached and more frequent meetings be held than have been in the past, and that by adopting the township or community unit all could attend, and in many localities monthly meetings could be held.

The committee on cooperation with other educational agencies recommended the adoption of a resolution, which was later presented, calling for the appointment of a national commission of agricultural education, whose duty it should be to map out the fundamental functions of the different types of institutions having educational work to do, and to present a full report, with recommendations as to how a balanced system of agricultural education can be developed with the utmost economy and efficiency and with a minimum of duplication of effort and waste of energy. The resolution was referred to the executive committee of the association for such action as it may deem best for carrying out the purpose of the resolution.

The committees on institute lecturers, movable schools of agriculture, and women's institutes likewise reported making recommendations for the improvement of the institute work in the several directions that the committees represent.

The subjects discussed in the rest of the program were arranged in three groups. The first embraced topics relating to institute effort along somewhat general lines. The second, cooperation; and the third, round-table exercises.

The conclusions reached respecting the special province of the farmers' institute were that there should be in our modern institute

meeting a well-defined purpose to make it prepare for more specialized and advanced kinds of extension; that there is a distinctive field for the institute but not an exclusive one; that the field belonging specially to the institute is chiefly in new territory, where there are no facilities in the way of halls for large undertakings like farmers' short courses and meetings of that nature; that the institute meeting, if it is true to itself and to the cause that it represents, must aim not only at better farming, but for the creation of other forms of extension work which will prepare the way for still better farming and all that comes with it.

It was held that the farmers' institute has a place in organized territory also, where the short course has come and the movable school of agriculture has been and through which the agricultural train has passed; that the situation is similar to that of our common schools in their relation to the university and college courses. The college does not supplant the common school. There still is need for the earlier steps in educational work to prepare for college work. So, although more advanced forms of extension exist, we still need the beginnings of extension which lead the way up to these more advanced forms. It was held that farmers' institutes should take the initiative, particularly in organizing local farmers' associations and clubs.

The relative values to the farmers of the one-day and two or three day institutes as compared to the cost were summed up in the following statements:

- (1) That one-day institutes are useful and economical in communities where the families are widely scattered and in other communities where the institute habit has not been established.
- (2) One-day institutes require maximum expense in time and travel.
- (3) Two-day institutes are the logical sequence to the one-day institute.
- (4) Two-day institutes are more economical of time in the field.
- (5) The three-day institute enables the workers to do a higher grade of instruction work so far as the individual is concerned, but reaches fewer persons.
- (6) So far as the present status of institute work is concerned we shall have to hold the three types, being governed by the special needs of each community and of each line of agricultural work.

In discussing "The relation of the institute to the agricultural college and experiment station," attention was directed to the fact that the institute system is a part of a larger organization and, therefore, must be prepared to cooperate with the various other forces at work for the betterment of agricultural conditions. That it need not be jealous of the other man's work since there is plenty

of room along every line for the exercise of the best activities of our most capable men. That the relationship between the college faculty and experiment station staff and the farmers' institute workers should be of the closest and most cordial character; that they should be mutually helpful, the one along practical lines and the other in the direction of scientific explanations of farm operations.

The use of the round-table method was declared to be very helpful in creating interest and in imparting information and should be more generally adopted. Plans for organizing institutes for women and young people were suggested and the system in use in Oklahoma was quoted as having been entirely successful.

In a paper upon the topic "Would an agricultural journal giving information regularly respecting farmers' institute and other forms of extension work be desirable?" the speaker maintained that such a journal would be highly desirable, but considered it impracticable from a financial point of view; that the constituency would be too limited to justify the expenditure necessary to make such a journal a success, and gave some data derived from his experience as a publisher of agricultural newspapers confirmatory of his position. He held that the only way such a publication could be successful would be by having it supported by State or National appropriation. In the subsequent discussion of the topic, attention was called to a journal published by the Department of Agriculture of the Province of Quebec, that had been eminently successful, and had proven to be self-supporting. Mention was also made of a similar publication in Australia that seems to have met with complete success. In both of these instances farmers' organizations receiving State aid were required to subscribe for a sufficient number of copies to supply all of their members. By this support and from the advertising received the journals had been able to maintain themselves and have proven highly beneficial to their readers.

In discussing the character of the State directors' annual report, it was held that the directors' report should be made to one or other of three groups of persons, viz, the farmers' institute board, the legislative assembly, to farm people or those interested in agriculture. That the report itself would be controlled in its form by the group to which it was addressed. If to the institute board, the plans for institute work should be outlined with considerable detail in order that what has been done might be understood thoroughly by those who are to pass upon the work. If the report is to be made to the legislature, it would doubtless be for the purpose of securing financial support for carrying on the work. In this case it would not be necessary to discuss methods and details so much as to present results and to demonstrate the safety and value of the investment and for this purpose it should be condensed, be virtually

a summary of money expended, work performed, and results accomplished. If the report is intended for the information of the agricultural population of the State, it should contain information respecting agricultural business and country life. The speaker held that the most valuable form of publication for the general public is that which treats pretty completely of a single subject, rather than of a multiplicity of subjects. He objected to the publication of photographs of individuals in such reports but was in favor of the free use of illustrative material in the way of cuts and diagrams necessary to a proper comprehension of a subject.

Attention was also called to the use that could be made of the subject matter of the report through having the articles printed as separates and kept for mailing to inquirers after information along the lines thus treated; as a spraying separate; one upon balanced rations; the feeding of beef animals; the care of poultry; the cultivation of alfalfa and similar topics.

Under the second group which related altogether to agricultural cooperation, two papers on "Obtaining credit" presented the European forms in use—the Landschaften, the Raiffeisen, and the Schultz-Delitch systems. There was also presented a "manual" giving exact information for the formation of the Raiffeisen banks, which had been translated by the Office of Experiment Stations, from a French edition.

Two papers were presented on "Agricultural cooperation for the purchase of supplies." Both of them with a third on "Farm insurance," will be published entire in the report of the proceedings. They gave in detail the operations of organizations engaged in these forms of cooperation.

The paper upon "Agricultural cooperation for providing farm labor" referred to the fact that no very satisfactory method had yet been discovered for providing farm labor at seasons when such labor was most needed. That there were four methods that had been adopted in various countries; the first was through the formation of cooperative societies designed to procure laborers from foreign countries or from urban centers and distribute them under contractual conditions among the individual members of the association. The second was the cooperative employment and use of crews of laborers for special tasks, as the weeding of vegetables, gathering of fruit, etc. The third, the cooperative or corporate association of the laborers themselves into companies for the purpose of performing certain services. Fourth, collective farming, either by small farmers or by gangs of laborers who obtain land on which to conduct agricultural enterprises in common. Of the four propositions, the speaker regarded that of the cooperative farm labor bureau and the cooperative employment of labor crews for the year or season as the most hopeful under our conditions and as most immediately practicable.

The last paper of this group was on "The federation of agricultural organizations." The speaker, after giving numerous instances of attempts at the federation, stated that, as a rule, organizations are unwilling to subordinate their individual interests to direction by a central bureau or head. While such an organization would, undoubtedly, exert powerful influence, there has not as yet been manifested a willingness to sink individuality for a common purpose. He expressed the opinion that organizations of this character to be effective must spring directly from the farming classes rather than from the ideas of financiers outside who undertake to aid the farmers in solving their problems. Such organizations usually fail because they do not come in close enough contact with the people whom they are supposed to be serving. He expressed the opinion that any sort of a rural organization or federation to be of the greatest use must enroll in its membership a large number of farmers and the demands and work of the organization must be largely directed by the rank and file of the farming classes.

Two hours were given to round-table discussions. The first was upon "The use of illustrative material in institute teaching"; and the second, upon "How farmers' institutes can assist in the formation of cooperative agricultural organizations." Both of these exercises were very interesting and furnished examples of the value of this method of giving instruction in the farmers' institute work. The president's address was delivered in the evening of the first day and was a discussion of the general agricultural situation as it exists in the United States. Attention was called specifically to some of the problems with which the farmers' institutes must deal. Among these were the avoiding of waste through improper farming; waste through lack of method in marketing; waste in the kitchen; waste of plant food on the farm; and waste through the maintenance of profitless animals. He spoke of the province of the institute association, its scope and its possible use, of the home on the farm, and the social relations that need bettering in our present rural life.

The officers chosen for the ensuing year were A. P. Sandles, Columbus, Ohio, president; J. H. Miller, Manhattan, Kans., vice president; John Hamilton, Washington, D. C., secretary-treasurer. The executive committee consists of the president and the secretary-treasurer, ex officio, with R. W. Thatcher, Pullman, Wash.; Mrs. F. L. Stevens, Mayaguez, P. R., and Andrew Elliott, Galt, Ontario.

EXTENSION WORK BY THE AGRICULTURAL COLLEGES.

Replies to a circular of inquiry sent to the agricultural colleges showed that extension divisions or departments have been organized by 48 colleges in 43 States; that 392 persons have been engaged in

this work. Of these 180 in 33 States gave their entire time and 212 in 32 States gave a portion of their time to extension service. Ten colleges reported that members of their faculties were engaged part of their time in extension work in addition to those regularly employed on the extension force, and one institution reported its entire faculty as engaged in this service. The amount of time devoted to this work by these persons and the number employed were not designated.

EXTENSION ACTIVITIES.

Among the activities specially reported were the organization of clubs and conducting contests in corn and tomato growing, pig rearing, fruit and vegetable production, canning, sewing, cookery, and stock judging. Also in organizing cow-testing associations; distributing pure seeds; organizing and conducting cooperative experiments; conducting field and orchard demonstrations; establishing county demonstration agencies; organizing and conducting courses for the preparation of teachers in agriculture; conducting movable schools, correspondence courses, and branch short courses; distributing leaflets of information; equipping and conducting instruction trains; carrying on farm surveys; and conducting educational practicals in connection with farmers' institutes. There is great diversity among the colleges in methods of operation as well as in the number employed in conducting extension activities, in the amount of money appropriated, and in the time devoted to extension work.

The recent extraordinary and rapid development of the extension feature in education has given rise in the agricultural colleges to questions of organization, administration, and forms of instruction whose proper solution is most important to the future success of this movement. Reports received by this office show great diversity of practice and view respecting these points, with very little that has been sufficiently developed to be recommended as generally applicable and altogether complete in detail.

There is need, therefore, for further discussion of the problems involved, particularly of those preliminary and essential features embraced by the terms organization and administration. The uniting of this new department of instruction with the other work of the institution so as to become an organic part of that work and representative of the instruction given by the college and of the researches and discoveries by the experiment station is most important and pressing.

ORGANIZATION OF THE EXTENSION DIVISION.

The following statements are intended to at least partially define this relation and to furnish a working outline or plan of procedure that may be followed and gradually perfected as the institutions gain

in experience and are equipped with men and material adequate for carrying it out.

(1) Responsibility for extension teaching in agriculture in a State should be located with the head of agricultural education and research—the agricultural college.

(2) The "extension division" should be organized as a distinct branch of the agricultural college coordinate with the division of interior instruction and the division of research (experiment station) and be supervised by a director and be responsible to the dean of the college in its general policy.

(3) The "extension faculty" should consist of the president or dean of the college of agriculture, the director of the extension division, the director of interior instruction, the director of the experiment station, and the extension officers ranking as full professors or as official heads of distinct branches of the extension work.

(4) The "extension force," including clerical as well as expert workers and instructors, should be under the immediate supervision of the director of extension work. These experts, so far as they represent lines of teaching and investigation conducted by the institution, should be approved by the head of the department corresponding to that particular line of instruction or investigation and be accountable to that head for the nature of their teaching and to the extension director for the method, time, and place of its presentation.

(5) The subjects and program for the work of the college, including the extension division, should be determined annually by the directors of research, teaching, and extension work, after consultation with the heads of departments and subject to the approval of the dean.

CONCENTRATION OF EFFORT.

Whatever is undertaken should be carefully worked out in all of its details and be subjected to the severest criticism by experts before being adopted. In making out the details regard should be had to efficiency; economy in money, time, and effort; ease of administration; and the value and permanence of the results.

If, for instance, a college concludes that its efforts should be directed to increasing production, then it should organize specially for that work and secure men who are informed in that particular, and devote its every energy to assisting agriculture along that special line. Or if it determines to improve the breeds of cattle in the State then it should concentrate on that and prosecute the work with all vigor. In this way only will most valuable permanent results to all of the people be secured, and the money and the men of the institution be utilized to best advantage. If the extension division scatters its efforts over many lines, unless it has large resources, it will fail to do any one thing in a way to be of decided and permanent benefit to the community.

A criticism that has sometimes been made of the farmers' institute is that it covers too many subjects and treats no one in a thorough and comprehensive way. It may be said, however, in defense of the institute in this respect, that its mission has been chiefly not so much to systematically teach agriculture and domestic art as to arouse interest in agriculture and agricultural education, to inspire men with a love and respect for scientific truth, for country life and country occupations.

THE OBLIGATION OF THE COLLEGE.

The college, on the other hand, is now to organize permanently an extension division for the purpose of following the interest that has been aroused with specific, exact, and extended information, giving it systematically and continuously, with deliberation, and with a view to more direct and greater permanent benefit than was possible for the institute. Haphazard, superficial, and fragmentary methods are out of place in extension by a college. To be of college grade the work must be accurate, substantial, and connected, bearing directly as possible upon the problems of rural life, upon the social and economic conditions with which country people have to do. It must be distinctly helpful. To be this it must be specific and practical, of a kind that the college can and will demonstrate in the community, and whose valuable results the college can and will guarantee.

This is no light undertaking. It will require large equipment, and, in the men who assume responsibility for its conduct, sound judgment, practical experience, and broad knowledge of the field of science as well as of the social and economic conditions of every section in which the college is to carry on its extension work.

THE ULTIMATE AIM OF COLLEGE EXTENSION EFFORT.

The leading purpose of the institution should be the development of a spirit of self-dependence in each community and in each individual of the community. Whatever is inaugurated should have in it therefore the element of self-help in the maximum degree and of dependence upon outside aid in a minimum and constantly diminishing degree. The aim should be to do in extension as the college now does with its resident students, fit them for standing alone, for helping themselves, equip them with ability to progress through the coming years by showing them where information of value can be had and how to use it.

In some States the people are no more independent of outside aid in the matter of holding farmers' institutes now than they were 15 or 20 years ago, while in others a large proportion of the meetings are held entirely by local people. This difference is due altogether to the methods employed by the directors in the several States.

The Raiffeisen system of banking is ideal and to be imitated in this respect, for it uses local people altogether for securing credit, requiring no assistance whatever from the State. The same is true of cooperative enterprises in Denmark and other European countries.

In the United States, Government assistance for discovering and making known the best methods of conducting agricultural operations and in establishing schools and other institutions for carrying on the work of rural improvement will be required for many years, but such aid should be less and less essential as the people become informed and organized, until a minimum only of such assistance will be required, and it should be the purpose of every institution giving information in agriculture to as rapidly as possible organize communities for this possible independence and ability to take care of themselves.

The secret of it all lies in organization—in the discovery of forms for carrying on extension work in the different directions required that will as far as possible be self-sustaining and capable of operation by local people. The paramount and primary requirement in extension work, whether the effort relate to the improvement of a school, a cooperative society, a rural club, an institute, a church, a farm, or a factory, is a method of operation that will be most simple and produce the most satisfactory results. We already have a vast amount of valuable information respecting agriculture. The devising of a method or set of methods for applying it—for introducing it into the practice of men generally—is the central requirement of the extension man or extension division of the agricultural college just now, and to this discovery the best ability and energy of the most capable men engaged in the extension movement should be devoted.

AGRICULTURAL EXTENSION WORK IN FOREIGN COUNTRIES.

Progress in agricultural extension work in foreign countries is of special interest to those in charge of similar work in the United States, since this method of fostering and improving the agriculture of a nation has been carried on abroad for many years with success, while in the United States it is of comparatively recent origin and has only lately attracted general attention. Its possibilities for general agricultural improvement are now recognized, and the past experiences of foreign nations in this respect are of importance in helping to shape the work in our own country during its formative period. The farmers' institute division of the Office of Experiment Stations of the United States Department of Agriculture published in 1905, a comprehensive report on the general status of agricultural extension abroad.¹ The present notes are, therefore, restricted to a few of the more important recent advances along this line.

¹ U. S. Dept. Agr., Office Expt. Stas. Bul. 163.

FRANCE.

Itinerant instruction in agriculture has existed for a long time in France under the form of conferences held by the departmental professors of agriculture and by specialists. The conferences have been confined to a limited field of action, having been held for the most part only on Sundays, and while of great benefit to mature farmers they have failed to reach the young men. Recently, movable schools of agriculture for young men from 18 to 30 years of age have been established with the object of filling the place between the regular school courses on the one hand and the conferences on the other, and are the direct outcome of the good results accomplished by the movable schools of housekeeping for young women. These movable schools, which are held only during the winter months, are also under the jurisdiction of the minister of agriculture and are conducted by the departmental professors. At least 30 young men must sign for the entire course in order that a school may be established in a community. The community must bear a certain part of the expenses, the remainder being supplied by the State.

It is interesting to note that out of the 40 days that the schools are in session 3 are devoted to a study of cooperative societies, agricultural associations, syndicates, mutual credit, and insurance. Without exception, the movable schools of agriculture for young men have been a success.

In the Department of Ardache there have recently been organized and conducted six movable dairy schools. Each school included four conferences upon the dairy industry and four practical meetings for the study of the manufacture of butter by the aid of modern machinery. All the meetings were well attended, there being present from 100 to 150 persons of both sexes. Certificates were given the last day to the better scholars. As a result of this instruction, better utensils are used in the dairies and better care is exercised in the treatment of milk. It has been found advisable for the Department to furnish all the utensils and equipment needed in this instruction, and not to rely upon the locality or upon the manufacturers to loan or give it.

The State allows for these departmental schools \$240, or \$40 per school. This amount has been used for the following expenses: Keeping the apparatus and utensils in repair; packing, transporting, and setting up the utensils; the renewal of small articles of equipment; the payment of help; the purchase of milk; providing diplomas; conducting correspondence; paying traveling expenses and hotel bills. All the movable dairy schools give both theoretical and practical instruction, one-sixth of the time being devoted to the former and the remaining five-sixths to the latter. The practical instruction includes examination of the best types of dairy cattle, inspection of apparatus, the preparation of feeds, and visits to dairy farms.

Four years ago movable schools of housekeeping were inaugurated in several Departments, and have been attended by a large number of young women. The important relation of farm women to the agriculture of the country is shown by the fact that they largely attend to the poultry that is reared and are responsible for the most of the dairy products, which in France equal the grain crop in value.

A movement is now in progress to greatly increase the number of movable schools in domestic economy and also to establish permanent schools in this subject, either independently or as departments in existing schools. It is found that in order that French farm women may be provided for to the extent that they are in Luxemburg there would be required 2,300 schools of domestic economy. An effort also is being taken to organize these permanent and movable schools in a manner similar to the system now established in Belgium.

Two kinds of movable schools are in operation in France—those that continue in one place for three weeks and those that continue in a place for three months and are therefore able to give quite thorough and detailed courses. These movable schools are under the jurisdiction of the minister of agriculture and are carried on by a liberal annual grant from the Government supplemented by certain expenses and supplies met and furnished by the locality in which the school is held.

DENMARK.

Itinerant instruction in agriculture in Denmark is usually provided for by the various agricultural associations which arrange with the professors in the secondary schools for the holding of various courses in the several regions, each course generally lasting two weeks. The instruction is adapted especially to the small farmers who can not attend an agricultural school, and is given in the form of conferences free of charge. The State gives \$4,200 annually for these courses and for similar itinerant courses in domestic economy. Instructors in the various agricultural subjects are engaged throughout the year in giving lectures and making demonstrations at these conferences. Besides the special meetings, there are held ordinary or general conferences at each place. Six instructors for the conferences are provided by the State, 11 by the Royal Agricultural Society, 80 by the agricultural associations, and 7 by the Society for the Cultivation of Land and Marsh.

All the above instructors except the seven from the last-named society are required to give itinerant instruction at the meetings organized by the Royal Agricultural Society. It is regarded as an important part of their duties that they attend the conferences that are held, and especially that they visit the farms, dairies, and other agricultural industries and give advice respecting their management.

The instructors and assistants engaged by the several agricultural districts hold each summer a reunion for instruction and for the dis-

cussion of important matters concerning their vocation. They receive instruction also in some special subject, as pathology, hydraulic agriculture, etc.

The agricultural "comitia" (voting assemblies) have formed a union which receives \$1,120 annually from the State with which to carry on conferences. The union is divided into four sections and the president of each section selects the instructors, who are to receive remuneration for their work. Conferences specially for small farmers are also held, for whose maintenance a like amount, \$1,120, is annually expended.

The State also contributes annually a sum of money to enable members of the various associations of small farmers, in groups of from 20 to 40 to visit under the guidance of a competent man the various small farms that are exceptionally good, the secondary agricultural schools, the demonstration fields, etc., situated in different parts of the country. After the inspection trip is completed the several groups unite to hold a conference, where the results of the inspection tour are discussed as well as other agricultural matters suggested by the trip. During 1910-11 the State gave for the above-mentioned inspection tours and for premiums for good culture among the small farmers the sum of \$32,200.

HUNGARY.

The Hungarian Government at considerable expense is endeavoring to improve the agricultural conditions of that country. Among the many organizations created for this purpose is the Bureau of Agricultural Intelligence. This bureau has given during the past year 3,309 informations of expert character free of charge. In order to provide farm laborers with employment during the winter, 549 courses of domestic industry have been held, attended during the year 1910 by 17,897 pupils. Eighty-five associations for promoting domestic industry were in operation during the year. The number of articles made was 737,067, which were sold for about \$110,000. There were also given 4,434 popular lectures, held in 80 voting contests, at which 300,450 persons were present.

Domestic industries, such as courses of instruction in wickerwork, fretwork, celluloid, basket and mat making, weaving, knitting, toy making, embroidering, etc., have been instituted. With the aid of various institutions the ministry has arranged for the sale of the products of these industries. In addition to these activities, banks, insurance bureaus, and mutual aid societies for rural people have been established. The ministry is also assisting in the formation of farmers' clubs at which subjects of common interest are discussed and lectures or courses of instruction are given. Besides the long list of schools of various grades conducted under the auspices of the

Hungarian Ministry of Agriculture, there are traveling professors giving instruction in the cultivation of hops, the cultivation and development of pastures, the production of potatoes, the growing of hemp and flax.

INDIA.

Experience in India has verified that which other countries have found to be true, that the farmers themselves must cooperate with the State departments of agriculture before any extended plans for their improvement can be made effective. The locality must become interested and go to work to carry out the suggestions for betterment that the central agencies propose. Recognition of this has led the leaders of agriculture in India to insist on the organization of numerous local bodies composed of cultivators who are committed to advanced and improved methods and who will agree to apply them in their own farming. The purpose is to establish in all communities societies that will introduce into the general practice whatever proves to be useful and adapted to the locality in which the demonstration is made. These local bodies are to be visited regularly by the Government instructors and encouragement and advice given them personally so that they may feel that the Government is working directly for the upbuilding of their interests.

In the central Provinces of India a most successful work has been accomplished by forming societies of a limited number of district officials. These officials are visited by a deputy director from the Government department of agriculture, who organizes them into societies and suggests the lines of work to be taken up, such as the use of new and improved seed, better methods of cultivation, the use of improved implements, or the perfecting of arrangements for marketing or selling produce, etc. Six months later the deputy again visits these organizations for conference. Once a year the various local bodies hold a round-up or common meeting at which this Government official is present. The department official always sees that each body has a definite work to accomplish. To do all this requires constant and much personal attention on the part of the department. Sanction has recently been obtained for the employment of eight high-salaried assistants for the supervision of district work. These men are the best the department can secure; and while they oversee experiments and farming operations, yet their principal work is that of supervising the assistants employed in conducting demonstrations.

In Bengal a similar system is adopted. There are three traveling inspectors and seven divisional inspectors, who work on behalf of the divisional associations and are under the control of the commissioner and the director of agriculture. In eastern Bengal a scheme has been experimentally sanctioned for the employment of district

agricultural officers, whose duty will be the dissemination of agricultural information. In Bombay development on the basis of four highly paid divisional inspectors has been continued. These, as previously indicated, are the best men in the departments, and control field men in every district, who follow up and carry out the work which they initiate. In Madras similar lines of development have been commenced and more are in contemplation. The fact that in all the Provinces quoted methods for development are similar indicates that the lines now adopted have been found to be satisfactory and possibly the only ones for effective itinerant work in that country.

RHODESIA.

In Rhodesia during the past year a systematic course of lectures corresponding to the American system of movable schools was given for three weeks at Salisbury. The success attending the first attempt at a systematic course of instruction in agricultural science marks a distinct forward step in the progress of the farming industry in that country. It had long been the intention to arrange such a course, but it had not before been found possible. The fact that upward of 70 persons attended the lectures while about 25 were present during the complete series showed that the people were ready for such instruction. A syllabus of the lectures of the entire course was given to each student. On several afternoons and on two Saturdays excursions were undertaken to farms in the neighborhood as well as to tobacco warehouses, the brewery, the forest nursery, and the inoculation station. In all, eight leading farms were visited and the crops, stock, and buildings inspected. Examinations held in the various subjects showed that the students were intelligently assimilating the instruction and utilizing to good advantage the opportunities afforded.

WORK OF THE OFFICE.

The work of the institute office has continued along the lines of previous years. Information respecting farmers' institutes and other forms of agricultural extension, both in this country and abroad, has been collected and prepared for publication, and addresses before farmers' associations and in educational institutions have been delivered.

The following publications have been prepared and published during the year: The annual report of the farmers' institute specialist; the report of the proceedings of the American Association of Farmers' Institute Workers; and an illustrated lecture on farm homes. There has been prepared a course of study on economic entomology, and there have been edited illustrated lectures on peanut culture, and on farm home grounds, their planting and care; a circular giving a list of

farmers' institute directors and lecturers; bulletins on course in the use and preparation of vegetable foods, and on educational contests in agriculture and home economics. There are in preparation statistics respecting agricultural extension by the agricultural colleges and experiment stations for the year 1912; a bulletin giving forms of charts for use by agricultural lecturers; outlines of plans for agricultural fair buildings and grounds; and statistical data showing the results of the work of the farmers' institutes upon agricultural production.

A large number of officials connected with the farmers' institute, extension departments, State departments of agriculture, and other associations interested in agricultural extension work have been visited and interviewed. The distribution of printed information has been continued, and the correspondence of the office, which has grown to considerable proportions, has been conducted.

The effort has been to develop some of the forms of extension that are now in operation throughout the country and to introduce new methods for use by State officials and college extension directors engaged in disseminating agricultural information and in itinerant instruction work. Perhaps the most important item in this direction has been the issuing of a course of study adapted to correspondence teaching and in detailed instructions for conducting extension work by this method. Investigations have been conducted to ascertain the effects of extension teaching by the various farmers' institutes upon agricultural people, and to secure data relative to the improvement of plans of buildings and grounds for local and State fair associations.

The collecting of information respecting agricultural extension work in foreign countries and preparing it for publication has been in the hands of the assistant farmers' institute specialist, Dr. J. M. Stedman, involving a large amount of time in consulting foreign journals, besides the translation of numerous letters, documents, and reports for the office files.

It will be seen by comparing the figures presented herein with those of previous years that there has been decided growth in institute activity and interest throughout the country notwithstanding the additional force of itinerant workers sent into this field by extension departments of the colleges and experiment stations.

In addition to the work of the farmers' institutes there has been that of the agricultural colleges and experiment stations along extension lines. The remarkable growth of this line of effort in connection with these educational institutions shows the demand that exists for agricultural information on the part of farming people and reveals the character and extent of the efforts made by the colleges and stations to meet this demand. That there is room

enough for all is clearly manifested as the extension field is developed. The demand is increasing for more and better workers along all lines of rural progress, and it will be many years before the supply will be equal to the need.

STATE REPORTS.

Numerous items of interest in the reports of the State directors are incapable of tabulation or are peculiar to a particular State and at the same time are important to a complete record and understanding of the progress of the institute work as it develops each year. In order that the great body of institute workers may be familiar with this progress the principal points are incorporated in the following accounts under the respective names of the States.

ALABAMA.

Institute director: C. A. Cary, professor of veterinary science, Alabama Polytechnic Institute, Auburn.

At each institute held during the year the subject of live stock on the farm and boll-weevil problems were discussed. The appropriation of \$1,600 was expended in conducting 33 general institutes of 54 sessions, having a total attendance of 5,115 and in holding a round-up institute lasting 6 days with 15 sessions, during which 60 lectures and demonstrations were given with 1,100 in attendance. Twelve lecturers from the faculty of the agricultural college and experiment station staff composed the institute force.

ALASKA.

Institute director: C. C. Georgeson, special agent in charge of agricultural experiment station, Sitka.

No report received.

ARIZONA.

Institute director: A. M. McOmie, superintendent of farmers' institutes, Tucson.

The various climatic conditions existing in the State, the scattered situation of the agricultural districts and the comparatively few settlers, together with the fact that most of them have recently come from practically every State and many foreign countries and have brought with them their native farm practices which they try to put into effect in the new region, all combine to make farmers' institute work in Arizona peculiarly difficult. Farmers' institutes in Arizona are, however, in a good, healthy, and growing condition although it does not appear when the attendance alone is used as a basis for comparison with that of any other State. For instance, in many places the institute attendance represented every person in the region, which in one place was only 43. It is, therefore, not a lack of interest that

makes the attendance so low, but it is due solely to a lack of agricultural population to draw from. The 63 general institutes of 124 sessions were attended by 9,356 people and the 4 high schools at which institute lecturers gave 40 days' service averaged 245 persons taught each day. The total cost of all the above, including salaries and the expenses of the State director, was only \$1,650.00.

ARKANSAS.

Institute director: J. M. Wilson, professor of extension, Fayetteville.

Institutes were held in every county in the State. In all, 204 general institutes of 408 sessions, with 24,515 persons in attendance, and 9 young people's institutes of 18 sessions with 1,026 in attendance were held. There were also 3 railroad instruction trains which made in all 79 stops and were attended by 9,883 persons. A short course of 20 sessions for demonstration agents was attended by 75. Ten college and station men contributed to the institute work, three of them all the time and the others as needed. Six local speakers addressed meetings. Four thousand dollars per year was appropriated for institute purposes, most of which was used for traveling expenses.

CALIFORNIA.

Institute director: W. T. Clarke, superintendent of university extension in agriculture, Berkeley.

A large number of local speakers are utilized in the institutes, 195 having given addresses during the year. Twenty-five State lecturers are on the institute force, of whom 10 from the agricultural college and experiment station contributed a total of 142 days' service. Institutes are conducted during the entire year because the slack season in California occurs at different periods in different parts of the State.

There were held during the year 107 regular institutes composed of 272 sessions and attended by 37,003 persons. Seven railroad instruction trains made in all 237 stops and the 21 lecturers addressed in all 102,624 persons. A farmers' week of 42 sessions had an attendance of 5,200 and a one-day picnic had 3,500 in attendance. One hundred and thirty-nine days were devoted by institute lecturers to giving agricultural instruction at teachers' institutes and various schools at which the total attendance was 7,350. The total cost of the institutes for the year was \$15,000.

COLORADO.

Institute director: C. H. Hinman, director of farmers' institutes, Fort Collins.

Thirty-eight members of the agricultural college faculty and experiment station staff spent a total of 311 days at institutes during the year, not counting the time going and returning. Five per-

sons devoted their full time to institutes and other forms of extension work in agriculture. There were held during the year 105 regular institutes of 233 sessions, at which 29,380 persons were present. There were also held 7 movable schools for men, consisting of a total of 50 days with 802 in attendance, and 2 movable schools for women, each of 5 days' duration with 73 in attendance. One railroad instruction train of 5 cars was run which made 51 stops and was attended by 5,211 people. Ten teachers' institutes for rural-school teachers were held, consisting of 88 sessions, at which the attendance was 5,535. Besides the above, institute lecturers conducted instruction in agricultural subjects for a total of 105 days at teachers' institutes and common schools, at which the total attendance was 6,450. The above activities cost \$5,159.

CONNECTICUT.

Institute director: L. H. Healey, secretary of State board of agriculture, Hartford.

The farmers' institute management has been combined under one head known as the Advisory Board of Farmer's Institutes, the secretary of agriculture being the secretary of the advisory board also. Institutes were held in every county in the State during the year, there having been 23 general institutes of 50 sessions with 2,687 in attendance, and 4 independent institutes with 3,000 people present, besides the annual three-day meeting of the dairymen, poultry men, beekeepers, fruit raisers, sheep breeders, and of the State board. Nineteen local speakers addressed the meetings in addition to 12 from the agricultural college and experiment station. Three persons were employed in field demonstration work for a few days. The total cost was \$619.15.

DELAWARE.

Institute director: Wesley Webb, secretary of State board of agriculture, Dover.

Twenty-one State lecturers, of whom 6 were from the agricultural college and experiment station, spent in all 30 days in conducting 20 general institutes of 58 sessions, at which the attendance was 8,540, and in lecturing on a railroad instruction train of 3 cars, which made 15 stops and had a total of 1,154 in attendance. The total cost was \$800.

FLORIDA.

Institute director: P. H. Rolfs, director of agricultural experiment station, Gainesville.

A monthly press bulletin is being issued by the extension office with the help of the staff of the experiment station. Field instruction to farmers has also been inaugurated. The entire time of two and one-third the time of one person is devoted to institutes and other forms of agricultural extension work. In addition to these, 10 other members of the agricultural college and experiment station devoted in

all 99 days to institute work. There were held 36 institutes of 64 sessions, with a total attendance of 4,748; four independent institutes with 206 in attendance, 30 special institutes, with an attendance of 7,000, and 3 railroad instruction trains, which made 71 stops and was attended by 31,169 persons. Besides the above, institute lecturers devoted 10 days to addressing normal and high schools, at which the attendance was 930. In all, \$8,000 was spent in conducting the above work.

GEORGIA.

Institute director: A. M. Soule, president of State college of agriculture, Athens.

The institute work is a division of the extension department of the agricultural college, and, therefore, it is difficult to draw a distinct line between them. Eight persons devote their whole time to the work and other members of the agricultural college and experiment station contribute considerable time to institute work. Seven persons devote half their time to field demonstration and advisory work with farmers. Women's and boys' and girls' institutes were combined with the general institutes, at least one special speaker being present at each institute to address them. There were held during the year 103 general institutes of 103 sessions at which 21,870 persons were present; 81 independent institutes with an attendance of 10,802; 1 round-up institute of 8 sessions with 800 persons present, and 243 other special institutes with a total of 56,376 in attendance. There were also held 19 movable schools for men, 19 for women, and 19 for young people, all lasting 4 days, at which the total attendance was 15,190. Eight persons devoted all their time to boys' and girls' clubs in connection with the common schools, the total registration of which was 12,500. Fourteen teachers' institutes of 41 sessions were addressed by 7 speakers, at which the attendance was 1,485. The total cost of all the above activities was \$7,500.

IDAHO.

Institute director: W. H. Olin, superintendent of extension, 439 Yates Building, Boise.

With an expenditure of \$3,900 and the employment of 10 persons from the agricultural college and experiment station, as well as 50 local speakers, the director held during the year 42 general institutes of 74 sessions, with an attendance of 11,607. He also conducted 9 movable schools for men of 6 days each, at which the attendance was 27,482, and 3 movable schools for women of 5 days each, at which the attendance was 1,125. He also ran 2 railroad instruction trains of 7 coaches each, which made a total of 77 stops, and were attended by 13,952 persons. In addition, 13 days were devoted to teachers' institutes, at which 2,650 persons were in attendance, 50 days to work with high schools, at which 1,000 were present, and 25 days to common schools, with a total of 1,500 pupils.

ILLINOIS.

Institute director: H. A. McKeene, secretary of Illinois farmers' institute, Springfield.

There were held during the year 197 general institutes of 802 sessions, at which the total attendance was 176,650, and 5 movable schools for men, women, and young people, each of 6 days' duration, at which 675 were registered. A round-up institute was held, attended by 3,000 persons. Each county in the State held institutes, the county boards appropriating \$8,300 for the work and the State \$27,650. One hundred and forty-six State lecturers were employed, 29 of them coming from the agricultural college and experiment station, who contributed 276 days' service to the work.

INDIANA.

Institute director: W. C. Latta, farmers' institute specialist, Lafayette.

Farmers' institute work in Indiana is confined to the holding of general institutes, the more recent forms of extension work being confined to the activities of the extension department. Farmers' institutes expended during the year \$18,750, which enabled them to hold 372 institutes, consisting of 1,201 sessions, at which a total of 174,758 persons were in attendance. They employed 55 State lecturers, of whom 13 were from the agricultural college and experiment station, and devoted in all 39 days to the work.

IOWA.

Institute director: A. R. Corey, secretary of State board of agriculture, Des Moines.

Institutes were held during the year in 77 counties out of the 99 in the State. There were held during the year 91 general institutes, consisting of 692 sessions, with 159,080 people in attendance; also 11 short courses, with a total of 275 sessions, at which the attendance was 52,045. The total cost was \$37,245.22.

KANSAS.

Institute director: J. H. Miller, superintendent of extension work, Manhattan.

With an expenditure of \$19,000 Kansas conducted during the year 342 general institutes of 902 sessions, at which 95,786 persons were present. Also one movable school for men lasting 3 days, at which 24 were registered, and 15 schools for women lasting 5 days each, at which 345 were present. Five railroad instruction trains of 5 cars each were run. They made a total of 293 stops, employed 44 lecturers, and met 58,337 people. There were also held 200 special meetings, at which the attendance was 50,000, and one round-up institute of 27 sessions, which was attended by 1,100 persons. The institute force also contributed 30 days' service to teachers' institutes, at which the attendance was 4,500, and 350 days' service to high schools, with

a total attendance of 70,000. Thirty-three State lecturers were employed, 17 of whom were from the agricultural college and experiment station, and contributed a total of 168 days to the work. There were also over 2,000 local speakers who addressed the meetings. Many of the institute lecturers are on the regular force in the extension department, their time being devoted to other forms of extension during a large part of the year, including farm advisory work, expert supervision in building silos, roads and bridges, spraying orchards and potato fields, organizing cow testing and cooperative breeding associations, etc.

KENTUCKY.

Institute director: J. W. Newman, commissioner of agriculture, labor, and statistics, Frankfort.

The State law provides for the holding of farmers' institutes in every county in the State each year, and for this purpose there was expended during the year \$14,200. In all, 119 institutes of 341 sessions were held, at which the total attendance was 10,474. The State employed 20 lecturers, 5 of whom were from the agricultural college and experiment station. One railroad instruction train of 8 cars carrying 11 lecturers was run. It made 106 stops, traveled 2,453 miles, and met 56,000 people. Five independent institutes of 9 sessions were also held, at which the attendance was 1,350. The institute work is to be broadened so as to include field demonstrations and itinerant instruction to individual farmers.

LOUISIANA.

Institute director: W. R. Dodson, director of State experiment station, Baton Rouge.

While a number of meetings were held in the State by the agricultural experiment station which were really farmers' institutes, none was held by the State department of agriculture, in which authority to conduct the institute work is placed by law. A railroad instruction train was also run by the experiment station, which was reported to have been successful.

MAINE.

Institute director: J. P. Buckley, commissioner of agriculture, Augusta.

The laws of Maine require the holding of two farmers' institutes in each county every year, and for this purpose \$3,000 was appropriated. There were held 119 general institutes, consisting of 184 sessions, with 7,394 people in attendance; also 66 sessions of special institutes, at which the attendance was 7,623. These special institutes consisted of State dairy conferences, meetings of dairy testing associations, breeders' associations, fruit growers' associations, etc. There were also conducted during the year nearly 50 demonstrations in spraying and pruning orchards.

MARYLAND.

Institute director: R. S. Hill, director of farmers' institutes, Upper Marlboro.

The institute force during the year consisted of 12 lecturers, 6 of whom were from the agricultural college and experiment station, who devoted a total of 20 days to the work. There were held in all 54 general institutes of 134 sessions, with an attendance of 18,535 persons. Three railroad instruction trains were run, consisting of from 4 to 5 cars each and carrying from 4 to 7 lecturers. They made in all 72 stops and were attended by 3,863 people. The total cost of the institutes was \$6,000.

MASSACHUSETTS.

Institute director: J. L. Ellsworth, secretary of State board of agriculture, Boston.

Two thousand two hundred and fifty-one dollars was expended during the year for farmers' institute work. Fifty-two lecturers were employed, of whom 20 were from the agricultural college and experiment station. One hundred and thirty-eight institutes, consisting of 192 sessions were held, with a total attendance of 24,192. There was also one round-up institute of 2 sessions, which had an attendance of 500.

MICHIGAN.

Institute director: L. R. Taft, superintendent of farmers' institutes, East Lansing.

There were held during the year 399 general institutes, consisting of 1,168 sessions, with a total attendance of 126,581, and 46 women's institutes of 50 sessions, with 4,653 persons in attendance. Two railroad instruction trains were run over 7 different roads for a total of 1,700 miles, making 144 stops. Eight to twelve lecturers were on each train, who addressed in all 19,130 people. There were employed during the year 45 State lecturers, 15 of whom were from the agricultural experiment station and devoted a total of 120 days to the work. The total cost amounted to \$9,000.

MINNESOTA.

Institute director: A. D. Wilson, superintendent of farmers' institutes, University Farm, St. Paul.

The farmers' institute work in Minnesota included only the general farmers' institute meetings, the rest of the extension instruction being included in the general agricultural extension work of the agricultural college. Twenty State lecturers were employed during the year in giving instruction at farmers' institutes, of which there were 226, with a total of 665 sessions and with an aggregate attendance of 119,182 persons. The total cost of this work was \$25,991.22.

MISSISSIPPI.

Institute director: R. H. Pate, director of farmers' institutes, Agricultural College.

During the year \$17,900 was expended for institute work, \$7,500 of which amount the State contributed and the local communities \$10,400. Nineteen State lecturers were employed, of whom 12 were from the agricultural college and experiment station. There were also 55 local speakers who made addresses at the meetings. There were held in all 233 general institutes, consisting of 398 sessions, with a total attendance of 45,242, and 9 sessions of independent institutes, with 2,500 in attendance; 15 sessions of round-up institutes, with 900 in attendance; and 15 sessions of other special institutes, at which 500 persons were present. The institute lecturers also spent 20 days in addressing teachers' institutes, at which the attendance was 1,500; 18 days in addressing high schools, with an attendance of 3,200; and 20 days in speaking in common schools, with 800 as the total attendance.

MISSOURI.

Institute director: T. C. Wilson, secretary of State board of agriculture, Columbia.

The farmers' institute force during the year consisted of 19 lecturers, 7 of whom were from the agricultural college and experiment station. There were held in all 246 general institutes, of 463 sessions, with a total attendance of 88,643; a 5-day school of instruction for institute lecturers was held at the agricultural college in July. The total cost of the institutes during the year was \$17,500.

MONTANA.

Institute director: F. S. Cooley, superintendent of farmers' institutes, Bozeman.

During the year 140 general institutes were held, consisting of 304 sessions, with a total attendance of 21,148 persons; also 14 sessions of independent institutes, at which the attendance was 5,600, and 6 sessions of special institutes, at which 2,000 persons were in attendance. The institute force spent 9 days giving instruction in teachers' institutes and 75 days in similar work at high schools. There were also held 2 movable schools, lasting 6 days each, with a total attendance of 91. Twenty-eight State lecturers were employed, 12 of whom from the agricultural college and experiment station devoted a total of 228 days to the work. The total cost was \$10,000.

NEBRASKA.

Institute director: C. W. Pugsley, superintendent of farmers' institutes, Lincoln.

At nearly every institute the subjects of corn and silos were discussed. Egg-candling and cream-testing demonstrations were also introduced. The State employed 68 lecturers. Twenty-three were

from the agricultural college and experiment station, who contributed a total of 119 days to the work. There were held 189 general institutes, consisting of 605 sessions, with a total attendance of 109,199, and 18 young people's institutes of 30 sessions, at which 10,000 were in attendance. There were also conducted 3 movable schools for men and 3 for women, each lasting 6 days, at which the total attendance was 400 for the men and 390 for the women. Nine movable schools for young people, lasting 5 days each, had a total of 991 pupils registered. There were 17 special institutes at which the attendance was 2,855. These consisted largely of institutes for the discussion of fruit interests, cooperation, etc. Six different railroad instruction trains were run a total of 5,183 miles, making in all 244 stops, equipped with 30 lecturers, who addressed an aggregate of 51,721 people. The special subject taught was seed corn. The institute lecturers also gave 8 days to teachers' institutes at which 875 were in attendance, 4 days to high schools with an attendance of 515, and 2 days to normal schools with an enrollment of 300. The appropriation by the State for institute work during the year was \$17,500.

NEVADA.

Institute director: J. E. Stubbs, president of Nevada State University, Reno.

No institutes were held during the year.

NEW HAMPSHIRE.

Institute director: N. J. Bachelder, secretary of State board of agriculture, Concord.

Twelve State lecturers were employed, and \$1,200 was expended in conducting 18 institutes consisting of 39 sessions at which the attendance was 6,000. Six persons from the agricultural college and experiment station devoted a total of 34 days to the work and 7 local speakers addressed meetings.

NEW JERSEY.

Institute director: Franklin Dye, secretary of State board of agriculture, Trenton.

A new feature of the work this year was the introduction of corn-growing clubs for boys and sewing and baking clubs for girls. Premiums were awarded at the institutes to the successful contestants, and great interest was shown in the work. Forty-five general institutes were held, consisting of 131 sessions, at which 7,710 persons were in attendance. Six railroad instruction trains of 4 cars each made in all 30 stops and carried 16 lecturers, who addressed 2,240 persons. A round-up institute in connection with the annual meeting of the State board was held, consisting of 7 sessions, at which the attendance was 1,765. There were 2 special potato institutes held, attended by 874 people. Fourteen State lecturers were employed, of whom 7

were members of the agricultural-college faculty and experiment-station staff. The total expense for the year, not including printing, was \$2,500.

NEW MEXICO.

Institute director: W. T. Conway, superintendent of agricultural extension, State college.

No regular farmers' institute fund was appropriated for this work, but the agricultural college and experiment station has endeavored to conduct as much institute work as could be done out of other funds, and which could be used for traveling expenses. Six members of the agricultural college and experiment station devoted 10 days during the year to 8 institutes, aggregating 11 sessions, at which the attendance was 200, and 1 railroad instruction train of 5 cars was run for a distance of 1,650 miles, during which it made 70 stops and was attended by 32,240 people.

NEW YORK.

Institute director: Edward Van Alstyne, director of institutes, Kinderhook.

Thirty-six thousand dollars was appropriated by the State for institute work, of which amount \$27,009 was expended between September 30, 1911, and July 30, 1912. Twenty-three members of the agricultural college and experiment station devoted a total of 214 days to the work, in addition to the regular institute staff. There were conducted 351 institutes, consisting of 1,200 sessions, at which the attendance was 116,311. There were also carried on 7 movable schools of 3 days each for men, with a total registration of 14,767. The institutes also assisted in the work of a railroad instruction train over the Delaware & Hudson. Nineteen independent institutes of 52 sessions were attended by 3,728 persons, and many other special institutes were held, at which the attendance ran into the thousands. The institute lecturers also spoke at teachers' institutes, devoting in all 87 days to the work and addressing 5,342 people. Likewise 85 days was devoted to work with common schools, at which the attendance was 12,599.

NORTH CAROLINA.

Institute director: T. B. Parker, director of farmers' institutes, Raleigh.

Institutes were held during the year in 97 out of the 100 counties in the State. Two hundred and thirty-four general institutes of 490 sessions were held attended by 37,109 people; and 229 institutes for women, consisting of 450 sessions, with an attendance of 20,317. Two instruction trains with 2 cars each made in all 40 stops and carried 10 lecturers who addressed 10,000 persons. There were also 25

independent institutes held consisting of 38 sessions at which the attendance was 3,879 and a round-up institute of 9 sessions at which 1,350 were in attendance. Four other special institutes, 3 of them for colored people, had a total attendance of 1,873. There were 31 State lecturers, 4 of whom were from the agricultural college and experiment station, who devoted in all 84 days to the work. The total expense was \$7,630. More money, however, will be available next year since the State has increased its appropriation \$3,000.

NORTH DAKOTA.

Institute director: T. A. Hoverstad, superintendent of farmers' institutes, Fargo.

The State made no appropriation for institute work, but private individuals contributed a total of \$11,000 for institute purposes and it resulted in institute work being done which was reported to be the largest and most successful in the history of the State. Twenty-six State lecturers were employed in addition to 25 local speakers. Forty-one general institutes of 124 sessions were attended by 16,559 people. A railroad instruction train of 9 cars carrying 41 lecturers made 41 stops and was attended by 53,650 people. There were also 53 special institutes at which 20,520 people were present.

OHIO.

Institute director: A. P. Sandles, secretary State board of agriculture, Columbus.

With 55 State lecturers and an expenditure of \$12,275.35 distributed equally among the 88 counties, there were held 341 general institutes consisting of 1,705 sessions at which 397,565 persons were in attendance. There were also conducted 60 independent institutes of 240 sessions at which 10,000 were present. A railroad train of 1 car carried 6 lecturers, made 150 stops, and met 200,000 people.

OKLAHOMA.

Institute director: E. P. Ansley, State superintendent of farmers' institutes, Oklahoma City; and Miss Irma Mathews, superintendent of women's institutes, Oklahoma City.

The State appropriated \$5,500 for farmers' institute work with men and \$5,000 for institute work with women, to be carried on under the direction of the State board of agriculture. In addition the agricultural college carried on extension work including movable schools and railroad instruction trains, but the latter are not included in the report of institute work. There were held during the year 259 general institutes of 1 session each at which 50,696 persons were in attendance. Likewise, 286 institutes for women consisting of 572 sessions at which the attendance was 20,929. Eight itinerant experts were employed for a time in giving personal advice to farmers and in

conducting demonstration work. Four experts devoted their entire time to institute work.

OREGON.

Institute director: R. D. Hetzel, director of extension department, Corvallis.

A new feature of the work this year was the inauguration of farmers' institute clubs in various parts of the State. The institute force also cooperated with the State superintendent of public instruction in carrying forward the school industrial movement culminating in school fairs being held all over the State. It is estimated that 75,000 boys and girls are taking part in this movement. A poultry demonstration car was operated over the Southern Pacific line in Willamette Valley, stopped at 50 towns, and was visited by 21,932 people. These special demonstration cars take the place of the railroad instruction trains previously operated covering several subjects. One instruction train of 4 cars was run which made 12 stops, and the 9 lecturers that accompanied it addressed 4,325 people. There were held during the year 72 general institutes of 115 sessions at which the total attendance was 10,633. A round-up institute was held with an attendance of 250. There were also a number of addresses given by institute people at picnics, chataquas, churches, banquets, conventions, commercial clubs, granges, and fairs, at which 13,400 people were addressed. The State employed 29 lecturers, all of whom were from the agricultural college and experiment station, and who contributed in all 450 days to the work. They also addressed teachers' institutes for 13 days at which the attendance was 2,295; and were employed 19 days in work in high schools with an attendance of 2,910 and 259 days with common schools at which the attendance was 41,165.

PENNSYLVANIA.

Institute director: A. L. Martin, deputy secretary of agriculture, Harrisburg.

A new feature of the institute work the past year was the development of class and school work in dairying, horticulture, and poultry. Five people were employed for 20 days in giving field demonstrations and personal advice to individual farmers. Seventy State lecturers were employed and 231 local speakers addressed meetings. Fifteen people from the agricultural college and experiment station devoted a total of 90 days to institute work including 63 days spent in addressing teachers' institutes and schools of various grades at which the total attendance was 7,000. There were held 222 general institutes consisting of 1,038 sessions with an attendance of 153,857; also two women's institutes of 4 sessions at which the attendance was 492, and 2 institutes for young people of 4 sessions at which the attendance was 492. Thirteen movable schools for men, women, and young

people lasting in all 52 days had 13,572 persons registered. There were in addition 60 sessions of independent institutes at which 20,000 people were in attendance and a round-up institute of 9 sessions having 2,800 persons in attendance.

RHODE ISLAND.

Institute director: John J. Dunn, secretary of State board of agriculture, Providence.

A marked increase of interest is being manifested in institute work, although no new features have been introduced. During the year \$485 was expended in institute work, which enabled the holding of 27 institutes consisting of 32 sessions, at which 2,595 people were in attendance. There were also 26 independent institutes held, with 1,300 people in attendance, and a round-up institute of 5 sessions, at which 1,295 people were present. Thirty State lecturers and 15 local speakers addressed meetings. This includes 12 lecturers from the agricultural college and experiment station.

SOUTH CAROLINA.

Institute director: W. L. English, State agent and superintendent of farmers' institutes and extension, Clemson College.

The farmers' institute work is a part of the extension division of the agricultural college, which has now been united with the farmers' cooperative demonstration work in connection with the United States Department of Agriculture. Each county now has a representative who makes all arrangements for holding the institutes. The total cost of the institutes during the year was \$3,400. Eighteen State lecturers were employed, 12 of whom were from the agricultural college and experiment station. They contributed in all 55 days to the work. There were held 83 general institutes of 153 sessions, having an attendance of 1,660, also 48 women's institutes of 96 sessions, and 52 young people's institutes of 80 sessions, at which the attendance was 1,550. Four movable schools for men of 4 days each had 190 in registration. There were also held 20 independent institutes, at which 1,500 persons were in attendance; a round-up institute of 9 sessions, with 750 in attendance; and 28 other special institutes, with 2,250 in attendance. One railroad instruction train of 7 cars was run, making 48 stops. There were 9 lecturers and 46,000 people were met and addressed.

SOUTH DAKOTA.

Institute director: H. H. Stoner, superintendent of farmers' institutes, Highmore.

Thirteen thousand dollars was expended during the year for institute purposes. Eight State lecturers were employed, 4 of whom were from the agricultural college and experiment station, and spent 25

days in the work. There were held 178 general institutes, with a total of 481 sessions, at which the attendance was 55,246. Seven independent institutes of 2 sessions each were attended by 4,699 people, and one special institute of 2 sessions had 500 in attendance.

TENNESSEE.

Institute director: T. F. Peck, commissioner of agriculture, Nashville.

There were held during the year 78 institutes of 84 sessions, at which the attendance was about 10,000. The State employed 8 lecturers, and an equal number from the agricultural college and experiment station were on the force that addressed the meetings. A railroad instruction train of 8 cars was run. It made 35 stops and the 25 lecturers who composed the teaching staff addressed 50,000 people. In all, \$5,000 was expended for the above work.

TEXAS.

Institute director: J. W. Neill, director of farmers' institutes, State board of agriculture, Austin.

Seventeen thousand five hundred dollars was expended during the year in conducting 714 institutes, consisting of a total of 744 sessions, at which the total attendance was 44,982. There was also a State round-up institute of 4 sessions, at which 500 people were in attendance. One speaker also accompanied a railroad instruction train. The total attendance was estimated to be 10,000.

UTAH.

Institute director: L. A. Merrill, director of extension division, 512 Vermont Building, Salt Lake City.

There were held during the year 166 general institutes of 324 sessions, having 43,354 people in attendance; 65 institutes for women of 111 sessions, with 21,677 in attendance; and 19 young people's institutes of 31 sessions, with 1,177 in attendance. Also a round-up institute of 33 sessions, at which the attendance was 13,200. Three railroad instruction trains of 4 cars made 62 stops, and the 8 lecturers addressed 36,659 people. Two State lecturers were employed, and 19 members of the agricultural college and experiment station contributed to the work; 5 of them their entire time, the others two weeks each. In all, \$10,000 was expended upon the work.

VERMONT.

Institute director: O. L. Martin, commissioner of agriculture, Plainfield.

Institute speakers were furnished at different times throughout the year to make addresses at granges, etc. Six State lecturers were employed. Five from the agricultural college and experiment station

devoted 16 days to the work. Two persons spent 20 days in field demonstrations and in giving advice to individual farmers. Thirty-four general institutes, consisting of 68 sessions, were held during the year at which 8,269 persons were in attendance. There were 4 independent institutes, attended by 1,000 persons. The total cost was \$2,500.

VIRGINIA.

Institute director: J. J. Owen, director of institutes, Richmond.

No report has been received.

WASHINGTON.

Institute director: Robert C. Ashby, superintendent farmers' institutes, Pullman.

Ten thousand dollars was expended during the year in carrying on the various activities of the institute work. Twenty State lecturers were employed and 18 members of the agricultural college and experiment station devoted 190 days' service to this work. Sixty-two days were spent in addressing teachers' institutes and various schools at which the total attendance was 3,730. There were held 68 general institutes of 216 sessions at which 16,505 people were in attendance. One railroad instruction train of 7 cars made 20 stops and the 11 lecturers addressed 3,784 people. There were also held 148 sessions of independent institutes at which the attendance was 13,844. In addition 4 movable schools for men with a total of 30 days had 5,420 persons in attendance, and 3 movable schools for women lasting a total of 24 days had 4,063 persons registered. One person was employed during the entire year in giving agricultural advice to individual farmers and in conducting field demonstration work.

WEST VIRGINIA.

Institute director: John M. Millan, secretary of board of agriculture, Charleston.

There were held during the year 102 general institutes, consisting of 510 sessions at which the total attendance was 37,543. The State employed 19 lecturers and \$6,203.20 was expended in the work.

WISCONSIN.

Institute director: G. McKerrow, director of farmers' institutes, Madison.

Forty State lecturers were employed in institute work during the year. Three members of the agricultural college and experiment station gave one day each to institute work. Nineteen thousand six hundred and eighty-eight dollars was expended in conducting the institutes, of which there were 135 general institutes, consisting of 675 sessions, at which the attendance was 107,598, and 41 women's institutes of 83 sessions, having 10,708 in attendance. There was

also a round-up institute of 11 sessions with an attendance of 3,923. The institute also took part in conducting a live-stock breeders' railroad instruction train.

WYOMING.

Institute director: H. G. Knight, director of agricultural experiment station, Laramie.

The State made no appropriation for institute work during the year. However, 5 State lecturers and 7 local speakers held one institute of 2 sessions, at which 121 persons were present.

STATISTICS OF FARMERS' INSTITUTES, 1912.

Number of institutes held and the approximate attendance during the year ended June 30, 1912.

New Mexico.....	7		1	86	1	7	7	351	234	229	248	243	1,200	116,311	18
New York.....	265	222	18	341	1	1	1	41	61	61	124	124	450	37,106	97
North Carolina.....	227	222	18	341	69	1	1	341	682	682	1,705	1,705	1,244	16,559	61
North Dakota.....	22							259	286	259	355	355	259	397,645	133
Ohio.....								72	72	77	115	115	10,633	50,696	233
Oklahoma.....	259	217	3	263	2	2	2	222	2	425	2	2	1,038	10,929	86
Oregon.....	68	2	2	2									4	153,857	92
Pennsylvania.....	19	2	2	2									4	492	148
Porto Rico.....															
Rhode Island.....	26		1					27		28		32		2,595	
South Carolina.....	75	48	52	8				83	48	52	91	48	52	80	81
South Dakota.....	61		110					178	302	178	302	481	96	1,660	9
Tennessee.....	75							3	3	3	84	9	9	55,246	114
Texas.....	684	47	19	24	17	2	1	714	714	744	744	744	10,000	10,000	108
Utah.....	140							166	65	19	19	324	111	44,982	60
Vermont.....	31									38	38	68	31	43,354	142
Virginia ³													8,269		121
Washington.....	39													16,505	
West Virginia.....	1													216	76
Wisconsin.....	1													510	74
Wyoming.....	1													675	156
Total.....	4,699	536	93	1,836	172	7	235	12	6,778	720	100	9,168	916	17,892	131
														1,375	
														163	
														2,456,178	
														78,776	
														14,245	
														131	

¹ No institutes held.² No data.³ No report.

Financial statistics of the farmers' institutes for the year ended June 30, 1912.

State or Territory.	Funds appropriated.		Cost of institutes.		Appropriation for the season 1913.
	By the State.	By the college and received from other sources.	Total cost.	Cost per session.	
Alabama.....		\$1,600.00	\$1,600.00	\$29.62	.....
Alaska ¹					
Arizona.....	\$1,600.00	50.00	1,650.00	13.30	\$2,500.00
Arkansas.....	4,000.00	.....	4,000.00	9.39	4,000.00
California.....	15,000.00	.....	15,000.00	55.14	15,000.00
Colorado.....	5,000.00	159.00	5,159.00	22.14	5,000.00
Connecticut.....	1,000.00	.....	819.15	16.38	.....
Delaware.....	800.00	150.00	950.00	16.38	600.00
Florida.....	8,000.00	.....	8,000.00	125.00	7,500.00
Georgia.....	2,500.00	5,000.00	7,500.00	72.81	2,500.00
Hawaii ¹					
Idaho.....	4,000.00	1,000.00	4,900.00	66.21	4,000.00
Illinois.....	27,650.00	8,300.00	35,950.00	44.82	27,650.00
Indiana.....	10,000.00	8,750.00	18,750.00	15.61	18,750.00
Iowa.....	13,176.33	32,492.18	37,245.22	53.82	7,425.00
Kansas.....	18,000.00	.....	18,000.00	19.95	20,000.00
Kentucky.....	16,000.00	.....	14,200.00	41.64	16,000.00
Louisiana ²					
Maine.....	3,000.00	.....	3,000.00	16.30	3,000.00
Maryland.....	6,000.00	.....	6,000.00	44.77	6,000.00
Massachusetts.....	5,000.00	.....	2,751.28	14.33	6,000.00
Michigan.....	8,500.00	1,500.00	9,000.00	7.39	8,500.00
Minnesota.....	23,000.00	3,054.37	25,991.22	39.08	23,000.00
Mississippi.....	7,500.00	10,400.00	17,900.00	45.00	7,500.00
Missouri.....	8,750.00	.....	8,750.00	18.89	.....
Montana.....	10,000.00	.....	10,000.00	32.89	10,000.00
Nebraska.....	17,500.00	800.00	18,300.00	28.81	17,500.00
Nevada ¹					
New Hampshire.....	1,200.00	400.00	1,600.00	41.02	1,200.00
New Jersey.....	2,500.00	.....	2,500.00	19.08	.....
New Mexico ²					
New York.....	54,807.01	.....	27,009.00	22.50	38,000.00
North Carolina.....	7,500.00	2,030.00	9,530.00	10.10	11,500.00
North Dakota.....	.....	11,000.00	11,000.00	88.71	6,000.00
Ohio.....	31,400.00	.....	27,400.00	16.07	31,400.00
Oklahoma.....	10,500.00	.....	10,500.00	40.16	.....
Oregon.....	2,500.00	3,600.00	6,100.00	53.04	2,500.00
Pennsylvania.....	25,500.00	.....	25,500.00	24.36	25,500.00
Porto Rico ³					
Rhode Island.....	600.00	.....	485.21	15.16	.....
South Carolina.....	.....	3,500.00	3,400.00	10.33	5,500.00
South Dakota.....	13,000.00	.....	13,000.00	27.02	13,000.00
Tennessee.....	5,000.00	.....	5,000.00	53.76	5,000.00
Texas.....	17,500.00	.....	17,500.00	23.52	17,500.00
Utah.....	10,000.00	1,000.00	11,000.00	23.60	10,000.00
Vermont.....	3,000.00	.....	3,000.00	44.12	.....
Virginia ³					
Washington.....	10,000.00	.....	10,000.00	46.29	10,000.00
West Virginia.....	8,203.20	.....	8,203.20	16.08	.....
Wisconsin.....	20,000.00	.....	19,688.89	25.97	20,000.00
Wyoming ²					
Total.....	439,186.54	94,785.55	487,832.17	25.10	409,525.00

¹ No institutes held.

² No data.

³ No report.

Number of lecturers employed by the State directors of farmers' institutes and reports of proceedings published for the year ended June 30, 1912.

State or Territory.	Total number of lecturers on the State force.	Number of members of agricultural college and experiment station staffs engaged in institute work.	Number of days contributed to institute work by agricultural college and experiment station lecturers.	Number of State lecturers giving agricultural instruction at—				Reports of proceedings.	
				Teachers' institutes.	High schools.	Normal schools.	Common schools.	Published.	Number of copies.
Alabama.		12						No.	
Alaska ¹ .								No.	
Arizona.	14	10	230		1			No.	
Arkansas.	10	10						No.	
California.	25	10	142	4	5	1	4	Yes.	12,500
Colorado.	31	38	311	8			5	No.	
Connecticut.	12	12	24					No.	
Delaware.	21	6	30					Yes.	3,000
Florida.	14	13	915		3	2		Yes.	15,000
Georgia.	15	15	653	7			8	Yes.	2,500
Hawaii ¹ .								No.	
Idaho.	10	10	200	1	5		1	No.	
Illinois.	146	29	276					Yes.	75,000
Indiana.	55	13	39					Yes.	1,000
Iowa.								No.	
Kansas.	33	17	168	4	350			No.	
Kentucky.	20	5						Yes.	20,000
Louisiana ² .								No.	
Maine.	5	5	5					Yes.	4,500
Maryland.	12	6	20					No.	
Massachusetts.	52	20						No.	
Michigan.	45	15	100					Yes.	12,500
Minnesota.	20							Yes.	50,000
Mississippi.	19	12	110	4	3		3	No.	
Missouri.	19	7	13					No.	
Montana.	28	12	228	4	15			No.	
Nebraska.	68	23	119	3	4	1		Yes.	
Nevada ¹ .								No.	
New Hampshire.	12	6	34					Yes.	1,500
New Jersey.	14	7						Yes.	6,000
New Mexico.	(3)	6	10					No.	
New York.		23	214					No.	
North Carolina.	31	4	84					Yes.	40,000
North Dakota.	26							Yes.	25,000
Ohio.	55							No.	
Oklahoma ² .								No.	
Oregon.	29	29	450	5	10		5	No.	
Pennsylvania.	70	15	90	10	5	3	10	No.	
Porto Rico ³ .								No.	
Rhode Island.	30	12	10					Yes.	700
South Carolina.	18	13	55					No.	
South Dakota.	8	4	25					No.	
Tennessee.	8	8						Yes.	3,000
Texas.	12	2	30	2				No.	
Utah.	2	19	1,224					Yes.	10,000
Vermont.	6	5	16					Yes.	3,000
Virginia ³ .								No.	
Washington.	20	18	190	3	4	2	6	No.	
West Virginia.	19							No.	
Wisconsin.	40	3	3	(2)	(2)	(2)	(2)	Yes.	50,000
Wyoming.	5	(2)	(2)					No.	
Total.	1,079	474	6,018	55	405	9	42		335,200

¹ No institutes held.

³ No report.

² No data.

Special institutes, including movable schools, railroad specials, independent and round-up institutes, picnics, fairs, conventions, and field demonstration meetings, for the year ended June 30, 1912.

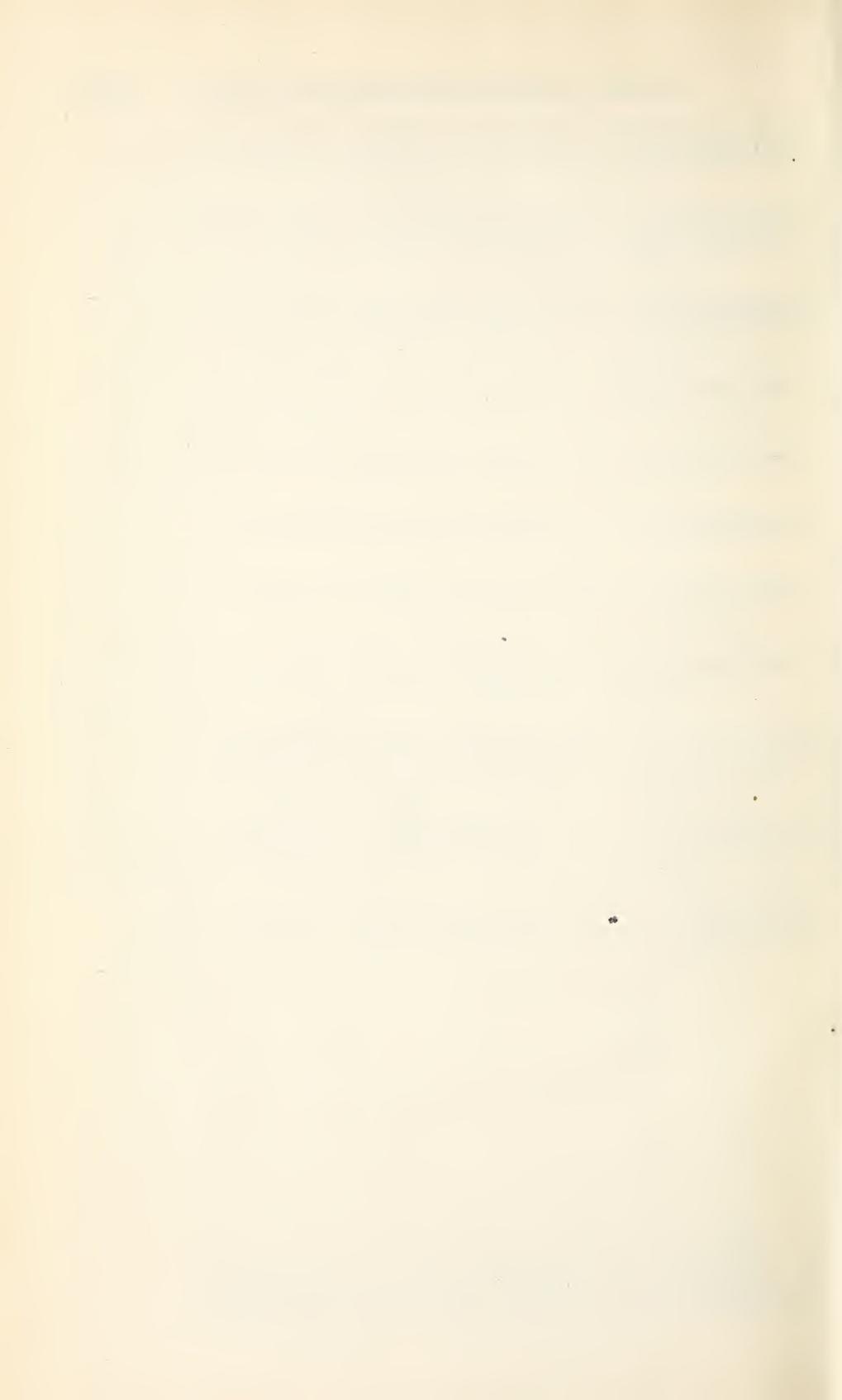
	Total	10,000	240	60	200,000	3	75,486	62	932	2,000	4	150	5
Oklahoma.....	5	30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	210,000
Oregon.....	13	52	13,572	2	.....	.....	.....	26,257	9	952	4	150	5
Pennsylvania.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	75,466
Porto Rico ⁴.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39,907
Rhode Island.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36,372
South Carolina.....	4	16	190	1	48	5,000	9	46,000	20	25	26	27	25
South Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,556
Tennessee.....	.....	.....	.....	.....	1	35	1,000	25	50,000	.....	.....	1	5
Texas.....	.....	.....	.....	3	62	.....	8	36,659	.....	.....	.....	1	9
Utah.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	2,556
Vermont.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50,690
Virginia ³	7	54	9,483	1	20	.....	11	3,784	111	148	13,844	1	5
Washington.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	5,199
West Virginia ².....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	50,000
Wisconsin.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	52,359
Wyoming ².....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1,000
Total.....	164	829	137,669	54	2,106	41,971	310	1,033,735	609	971	138,598	17	166

¹ No institutes held.² No report.³ No data⁴ No report.

Comparative statement of farmers' institutes.

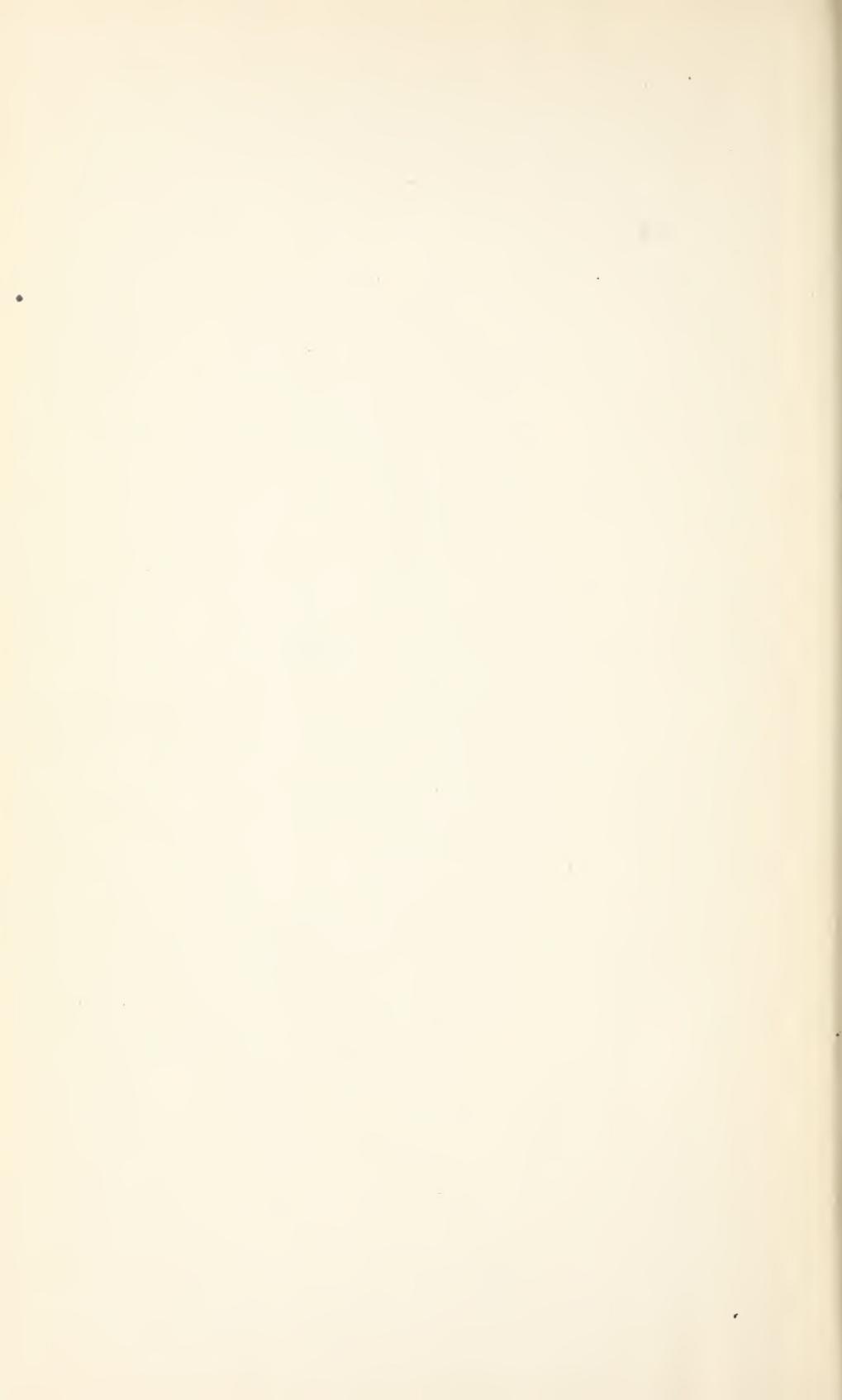
Tennessee.....	5,000.00	5,000.00	5,000.00	5,000.00	98	23	42	81	8,910	4,142	10,000
Texas.....	5,000.00	5,000.00	17,500.00	498	744	130	292	714	3,238	23,360	44,982
Utah.....	6,442.35	6,000.00	11,000.00	61	466	31	49	250	29,573	5,945	66,208
Vermont.....	1,500.00	3,750.00	3,000.00	83	68	37	50	34	5,190	7,660	8,269
Virginia.....	4,000.00	5,000.00	(2)	110	(2)	236	55	(2)	22,000	6,000	(2)
Washington.....	8,750.00	8,500.00	10,000.00	102	216	65	34	68	14,083	5,578	16,505
West Virginia.....	6,630.00	8,000.00	8,203.20	401	510	84	88	102	27,398	26,100	37,543
Wisconsin.....	20,000.00	20,000.00	20,000.00	751	758	133	178	176	100,519	113,666	118,306
Wyoming.....	1,737.54	1,000.00	(3)	10	2	17	2	1	4,108	676	121
Total.....	432,374.25	432,693.47	533,972.09	16,741	19,430	5,651	5,889	7,598	2,395,908	2,291,857	2,549,199

¹ No institutes held.² No report.³ No data.



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